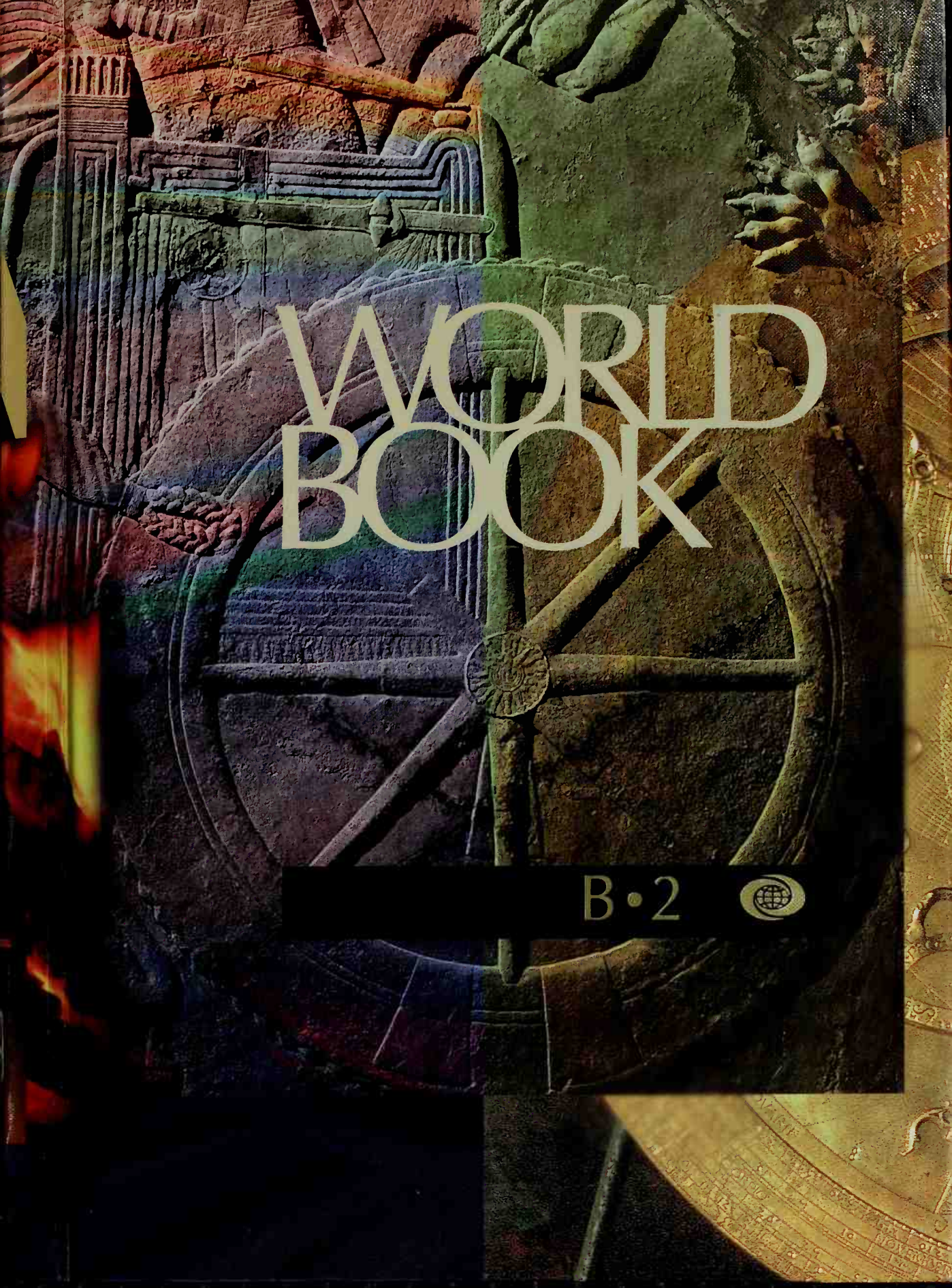
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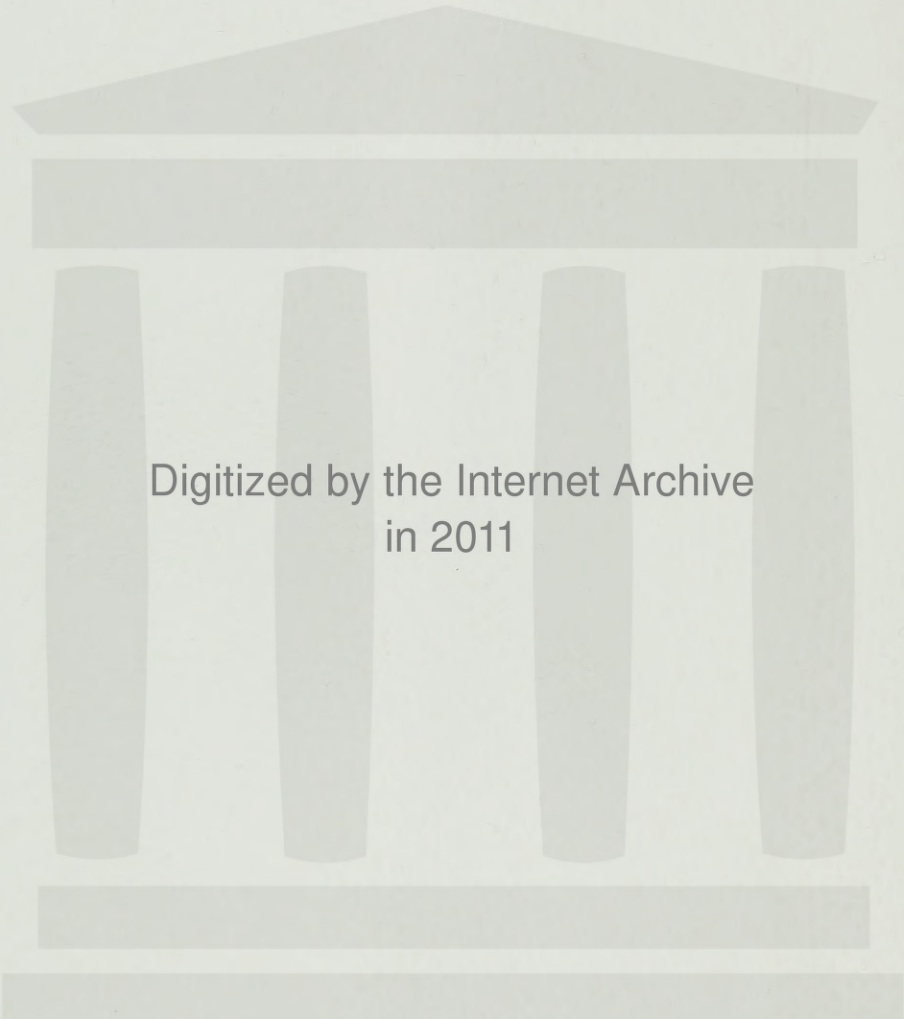

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Bb

B is the second letter of our alphabet. It was also the second letter in the alphabet used by the Semites, who once lived in Syria and Palestine. They called it *beth,* their word for *house.* Historians believe the word came from an Egyptian *hieroglyphic* (word picture) for a house. The Greeks borrowed the letter from the Phoenicians and called it *beta.* Our word *alphabet* comes from the names of the first two letters of the Greek alphabet, *alpha* and *beta.* See **Alphabet.**

Uses. *B* or *b* ranks about 20th in frequency of use in books, newspapers, and other printed material in English. When used on a report card, *B* usually means good work, just short of excellent. It often represents second in a group, as in Company B or Class B. As an abbreviation, *B* stands for the element *boron* in chemistry. In college degrees, it stands for *bachelor,* as in B.A., bachelor of arts. Musicians use it for *bass* or *basso.* In chess problems, it indicates a *bishop.* Dentists use *b* to show a *bicuspid* tooth.

Pronunciation. In English, a person makes the sound of the letter *b* with the lips closed, the tongue below the lower teethridge, and the vocal cords vibrating. In some English words, among them *comb* and *debt,* the letter is not sounded. In French, German, and other European languages, *b* has much the same sound as in English. See **Pronunciation.**

Marianne Cooley

Development of the letter B

The ancient Egyptians, about 3000 B.C., drew this symbol of a house.

The Semites modified the Egyptian symbol about 1500 B.C. They called the letter *beth,* their word for *house.*

The Phoenicians, about 1000 B.C., drew a symbol of a house and doorway.

The Greeks changed the Phoenician symbol and added it to their alphabet about 600 B.C. They called the letter *beta.*

The Romans rounded the B to its present form about A.D. 114.

The small letter b appeared during the A.D. 300's. It was faster to write than the capital. By about 1500, the letter had its present shape.

A.D. 300 Today

Special ways of expressing the letter B

International Morse Code

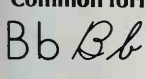
Braille

International Flag Code

Semaphore Code

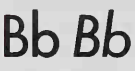
Sign Language Alphabet

Common forms of the letter B



Handwritten letters vary from person to person. *Manuscript* (printed) letters, *left,* have simple curves and straight lines. Cursive letters, *right,* have flowing lines.

Roman letters have small finishing strokes called *serifs* that extend from the main strokes. The type face shown above is Baskerville. The italic form appears at the right.



Sans-serif letters are also called *gothic letters.* They have no serifs. The type face shown above is called Futura. The italic form of Futura appears at the right.

Computer letters have special shapes. Computers can "read" these letters either optically or by means of the magnetic ink with which the letters may be printed.

Baal, *BAY uhl* or *bayl,* was a chief god of the Canaanites in Biblical times. The word means *lord* or *master* and was sometimes used to apply to the God of Israel. But it generally refers to the Canaanite storm god, who supposedly brought rain to make the soil fertile. Because the Israelites who settled in Canaan also wanted fertility for their flocks and crops, they were tempted to worship Baal. Queen Jezebel, the wife of King Ahab of Israel, worshiped Baal. She tried to convert the Israelites but was opposed by the prophet Elijah (I Kings 18:18–40). The rivalry of Baal remained a problem for the Israelite religion until the Babylonian conquest of the kingdom of Judah in 587 or 586 B.C. H. Darrell Lance

Ba'al Shem Tov, *bahl shehm tohv* (1700?-1760), a Jewish teacher, was the leading founder of the religious movement called Hasidism. Hasidism originated in the mid-1700's and became one of the most powerful movements in modern Jewish history.

Ba'al Shem Tov was born in a part of Poland that is now Ukraine. His original name was Israel ben Eliezer. Ba'al Shem Tov, also known by the abbreviation *Besht,* traveled widely in eastern Europe. He was the subject of many stories that told of his religious leadership and healing powers. He taught that people must worship God constantly, not just when they prayed or performed other religious deeds. He stressed joy in the worship of God and opposed fasting and other forms of self-denial. He emphasized the ability of the common person to attain heights of perfection in both the worship of God and in relations with other people. Today, Hasidism is practiced by some Jews in Europe, Israel, and the United States.

The Hebrew words *ba'al shem tov,* which mean *master of the good name,* indicate he was believed to be a miracle worker. Jews believed a ba'al shem could perform miracles by reciting and writing the names for God. A ba'al shem was thought to be able to heal through the power of the names. Lawrence H. Schiffman

See also **Hasidism; Jews** (Eastern European religious movements).

Babar. See Babur.

Babbage, Charles (1791-1871), was an English mathematician known for his designs of two mechanical computing machines. These designs were based on some of the same principles that were later applied to electronic digital computers.

Babbage was born in Surrey County. He began developing his first machine, called the *difference engine,* in the early 1820's. This machine was intended to calculate and print simple mathematical tables. In the 1830's, Babbage turned his attention from the difference engine—which he never completed—to another computing machine, the *analytical engine.* This device was designed to perform complicated calculations according to a sequence of instructions. Babbage never built even a working model of the analytical engine. The technology of the time was not advanced enough, and Babbage lacked funding for the project. Babbage helped found the Astronomical Society (now the Royal Astronomical Society) and several other organizations. He was also the author of many books, including *On the Economy of Machinery and Manufactures* (1832). Arthur Gittleman

Babbitt metals are special kinds of alloys used to line the bearings of cranks, axles, and similar moving parts. They can be bonded to the bearings by mechanical or chemical means. Babbitt metals reduce friction and keep the bearings from becoming too hot. They consist mainly of tin or lead with smaller amounts of copper, antimony, or other metal. Other elements may be added to achieve special properties. For example, arsenic improves the ability of the metals to withstand high temperatures. In use, the soft metals of the bearing conform to the shape of the axle they enclose. The alloys are named for the inventor Isaac Babbitt. I. Melvin Bernstein

Babbler is the name of a large, varied group of birds found mainly in the forests of Africa, southern Asia, and Australia. One species, the *wrentit,* lives along the Pacific Coast of North America. Babblers get their name from the loud, repeated calls they make.

There are about 250 species of babblers. Most are small- to medium-sized birds with short wings and strong, sturdy legs and large feet. They are weak fliers. The color of babblers varies widely. Most species, such as the white-crested laughing thrush, are a combination of brown, black, gray, chestnut, or white. But some babblers have bright green, yellow, or red feathers.

Babblers eat chiefly insects and other small animals without backbones. Most species find their prey by scratching and probing among the leaves and plants on the forest floor. However, some species look for food in shrubs and trees. Most babblers nest in low bushes or small trees. They generally build open, cup-shaped nests of twigs and stems, but some species cover their nests with a dome of grass and moss. Female babblers lay from two to four eggs. Among some species, the young remain with their parents for one or two years.

Most babblers gather in large flocks except when nesting. The birds call loudly to each other unless danger threatens. To escape danger, babblers often use their strong legs to run and hide rather than fly away.

David M. Niles

Scientific classification. Most biologists classify the babblers as forming the subfamily Timaliinae of the family Muscicapidae.

WORLD BOOK illustration by John Rignall, Linden Artists, Ltd.

An Asian babbler, the white-crested laughing thrush, is one of the largest types of babblers. It grows about 12 inches (30 centimeters) long and is about the same size as a blue jay.

Babel, Tower of. See Tower of Babel.

Babi Yar, *bah bee YAHR,* was a ravine near Kiev in the Soviet Union and the site of one of the largest massacres in history. The Nazis murdered about 35,000 Jews there on Sept. 29-30, 1941, during World War II.

The German army had captured Kiev and posted notices ordering the city's Jews to report for resettlement. The victims, carrying their belongings, marched to Babi Yar ravine, where special German military units machine-gunned them. By 1943, when the Germans retreated, the ravine had become a mass grave for more than 100,000 persons, most of them Jews. The Germans burned the bodies to destroy evidence of the deaths.

In 1961, Yevgeny Yevtushenko, a Soviet poet, wrote a poem called "Babi Yar" attacking prejudice against Jews. Dimitri Shostakovich, a Soviet composer, based part of his Symphony No. 13 (1962), also called *Babi Yar,* on Yevtushenko's poem. Leon A. Jick

Babies'-breath. See Baby's-breath.

Babies'-slippers. See Bird's-foot trefoil.

Babirusa, *bab uh ROO suh,* is a wild hog found in Indonesia. The babirusa has rough, brownish-gray skin that may be wrinkled. The animal is almost hairless, with only a thin covering of white or gray bristles. It has small ears and a short, hairless tail. The male has tusks that grow from the top of the snout and curve backward to the forehead. Females have shorter tusks. Babirusas range in height from 25 to 30 inches (65 to 80 centimeters), and they can weigh up to 200 pounds (90 kilograms). They eat mainly fruits and grasses.

Tom McHugh, Photo Researchers

The babirusa is a wild hog that lives in Indonesia. It has rough, brownish-gray skin, small ears, and a short tail. Male babirusas, such as the one shown here, have long tusks.

Babirusas have been heavily hunted for food by native people. They are considered a threatened species and are protected by law from hunters. William L. Franklin

Scientific classification. The babirusa is in the pig family, Suidae. It is *Babyrousa babyrussa.*

Baboon is a type of large monkey. A baboon has a large head and long, sharp canine teeth, and a muzzle much like that of a dog. A baboon's arms are about as long as its legs. Some baboons have short, stumpy tails, but others have tails more than 2 feet (60 centimeters) long. Male baboons are much larger than the females and have longer canine teeth. Some female baboons weigh as little as 24 pounds (11 kilograms). A male baboon may weigh 90 pounds (41 kilograms).

Baboons live mostly on the ground but sleep in such places as trees or cliffs. Several kinds of baboons live in Africa and southwestern Arabia. These include the *hamadryas* baboon, which lives on plains and rocky hills of Saudi Arabia, Yemen, and eastern Africa near the Red Sea, and the *chacma* baboon, which inhabits rocky regions and open woodlands in southern Africa. Male hamadryas baboons have long, gray hair on the head and shoulders. Chacma baboons have grayish-brown body hair and a long ruff of hair around the neck. Males occasionally kill mammals and share the meat with other group members.

© Tom McHugh, Photo Researchers

Female baboons take loving care of their young. A mother baboon, *left,* nurses her baby. Infant baboons depend on their mothers for food and protection.

Baboons live in groups of from 10 to 200 animals. A majority of the groups have more females than males. Groups are ruled by several large males. Hamadryas baboons live in *harems* composed of one male and several females and their young. A large number of harems band together to form large groups. The males are fierce fighters and protect the group.

Baboons eat eggs, fruits, grass, insects, and roots. They can carry food in pouches inside their cheeks.

Drills and mandrills are closely related to baboons. These two types of monkeys live in forests and are sometimes called *forest baboons.* Randall L. Susman

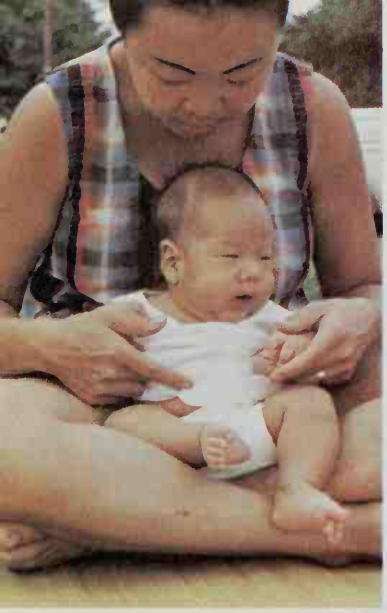
See also **Mandrill; Monkey** (picture).

Scientific classification. Baboons belong to the Old World monkey family, Cercopithecidae. The scientific name for the chacma is *Papio ursinus.* The hamadryas is *P. hamadryas.*

Babur, *BAH buhr,* also spelled Babar (1483-1530), was a Turkish prince who founded the Mughal Empire in India. He ruled from 1526 until his death. During his reign, the empire took over most of northern India.

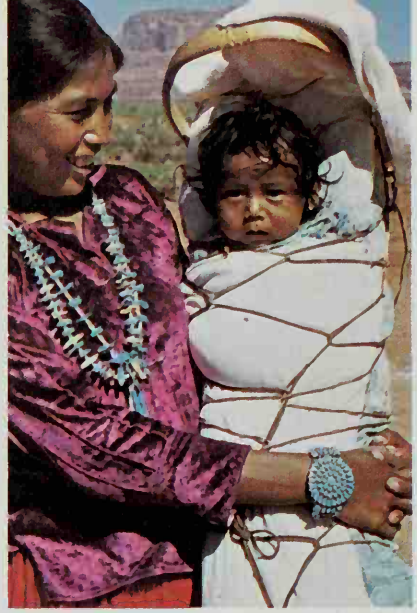
Babur was born in a kingdom in central Asia. He was a descendant of two powerful conquerors, Genghis Khan and Timur (also called Tamerlane). Babur spent his early life trying unsuccessfully to conquer Samarqand, a city in what is now Uzbekistan. Samarqand had been Timur's capital. Babur then turned his attention to northern India, which was ruled by an Afghan sultanate and Bengali princes. From 1526 to 1529, Babur conquered their territories. Babur's memoirs have been translated into English. Patricia Risso

See also **Akbar; India** (The Mughal Empire).



Jenny Watanabe

Japanese mother and baby



Emil Muench

Navajo mother and baby

United Nations

Jamaican father and baby

Babies of different cultures may receive somewhat different kinds of care. But in all cultures, close and loving contact, as shown by the parents above, is basic to a baby's development.

Baby

Baby, also called *infant,* is a child up to about 18 months of age. Almost everyone loves babies. They are among the most talked-about and most photographed subjects in the world. Poets have praised them, and painters have pictured them as models of innocence. But throughout most of history, people had to accept the fact that many babies would die of disease or hunger before they were 1 year old.

Since the late 1800's, advances in medicine, public health, and food production have sharply reduced the number of infant deaths in many parts of the world. The greatest progress has been in the industrial countries, especially Australia, Canada, Japan, New Zealand, the United States, and most Western European nations. Today, less than 1 per cent of the babies born in these countries die before the age of 1 year. Progress has been much slower in the nonindustrial countries of Africa, Asia, and Latin America. In some African and Asian countries, more than 20 per cent of all babies die before they are 1 year old.

Newborn babies are completely helpless. They cannot sit up, move from one place to another, feed themselves, or talk. Crying is their only means of telling people when they are hungry, unhappy, or hurt. With good care, babies gradually learn to do certain things for themselves. By the time they are about 18 months of age, most children can walk and run without help, feed themselves, play simple games, and say a few words and phrases. They are then no longer considered to be infants.

Duane F. Alexander, the contributor of this article, is Director of the National Institute of Child Health and Human Development at the National Institutes of Health.

This article traces the development and growth of babies from before birth through infancy. It also discusses baby care. For more information on the growth and behavior of babies and of older children, see the articles **Child; Growth.** For information about the young of various kinds of animals, see **Animal** (How animals raise their young).

Before birth

For a baby to develop, a *sperm* (sex cell from the father) must unite with an *egg* (sex cell from the mother). This union of a sperm and an egg is called *fertilization.* It produces a single cell called a *fertilized egg.* By a series of remarkable changes, the fertilized egg gradually develops into a baby.

A baby develops in the *uterus,* or *womb*—a hollow, muscular organ in the mother's abdomen. The period of development in the uterus lasts about nine months in most cases. During this period, development is more rapid than at any time after birth.

A fertilized egg is smaller than a grain of sand. Yet it contains a complete "blueprint" for the growth and development of a new individual. The blueprint consists of 46 tiny structures called *chromosomes.* Half of them come from the mother's egg, and half come from the father's sperm. Together, the chromosomes carry all the characteristics that babies inherit from their parents. These characteristics include general body build, eye and hair color, and other physical traits as well as mental ability. To learn more about how we inherit various characteristics, see **Heredity.**

The developing baby. A baby goes through two major stages of development before birth. During the first stage, which lasts about two months, a developing baby is called an *embryo.* During the second stage, which lasts about seven months or until birth, it is called a *fetus.* Growth takes place during both of these stages by *cell division.*

The first cell division in a baby's development occurs when the fertilized egg divides in two. This division happens almost immediately after fertilization. Before the cell divides, the chromosomes duplicate themselves. The resulting two cells thus have an identical set of 46 chromosomes each. These two cells then grow and divide, producing four cells with identical sets of chromosomes. The cells grow and divide over and over again, with each cell producing an exact duplicate of itself. The cells form an irregularly shaped, hollow ball, which becomes attached to the lining of the uterus. This tiny mass of multiplying cells forms the beginning of the embryo. A thin layer of tissue called the *amniotic sac* surrounds the developing embryo.

About a week after the first cell division, the cells that make up the embryo start to specialize. Groups of cells thus begin to form different organs, such as the brain and heart. The connection with the uterus develops into the *placenta,* an organ composed largely of blood vessels. The placenta is attached to the wall of the uterus. A tubelike structure called the *umbilical cord* joins the placenta to the embryo at the abdomen.

The placenta supplies everything that the embryo needs to live and grow. The placenta absorbs nourishment and oxygen from the mother's blood and transmits them to the embryo through the umbilical cord. Carbon dioxide and other waste products from the embryo travel through the umbilical cord to the placenta, which releases them into the mother's bloodstream. The placenta performs these functions until the baby is born.

By the end of the second month, the embryo measures about 1 inch (2.5 centimeters) long and weighs about $\frac{1}{2}$ ounce (14 grams). Although it is small and undeveloped, it has all the basic organs and features of a human being. The developing baby is now called a fetus.

After the second month, the organs gradually mature, and the fetus shows the first signs of movement. Meanwhile, the amniotic sac has filled with a salty fluid. The fetus floats freely in this fluid, limited only by the umbilical cord. The fetus can twist and turn in every direction and even make somersaults in the amniotic sac. The mother may begin to feel these movements during the fifth month of pregnancy.

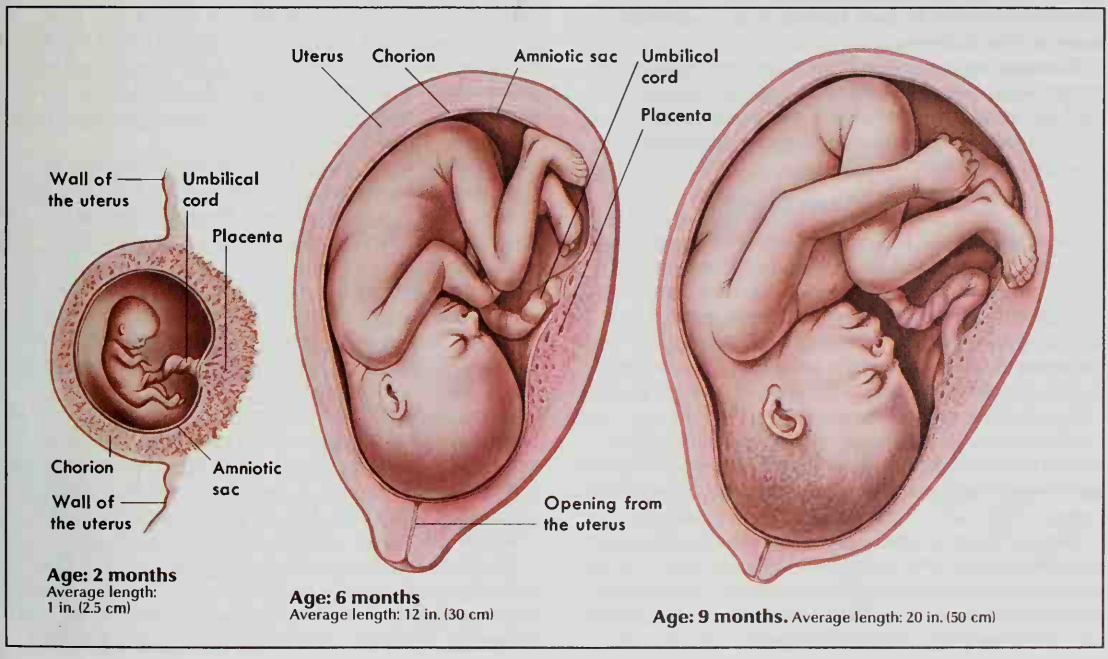
By the end of the ninth month, the fetus is well developed and ready to be born. Some infants are born *prematurely*—that is, before the ninth month. Premature babies born after the seventh month of pregnancy have a good chance of surviving and developing normally if they receive special medical care. Babies born as early as the sixth month of pregnancy may also survive, but complications are common.

The expectant mother. An expectant mother should receive medical care and lead a healthy lifestyle to protect the health of her baby. The first weeks of pregnancy, when the embryo begins to develop, are especially important. For this reason, a woman should have a physical examination as soon as she learns she is pregnant. In addition, she should arrange for regular physical checkups throughout her pregnancy. The

A baby's development before birth

A baby begins to develop as a mass of cells in the wall of the *uterus*—a hollow organ in the mother's abdomen. The developing baby is surrounded by a thin inner layer of tissue called the *amniotic sac* and a thicker outer layer called the *chorion.* By the end of the second month, *below left,* the baby has basic human features. Part of the chorion has become the *placenta.* This organ gives the baby nourishment and oxygen from the mother's blood through the *umbilical cord.* By the end of the sixth month, *center,* the baby fills the expanding uterus, and the chorion has largely disappeared. The baby is ready to be born by the end of the ninth month, *right.*

WORLD BOOK illustrations by Robert Demarest



examination and checkups help a doctor prescribe the kind of *prenatal care* that an expectant mother should receive.

Most women require more food, especially foods high in proteins, after they become pregnant. But weight gain should be gradual. A sudden gain may indicate a physical disorder. Meals should provide the same nourishment as any well-balanced diet (see **Nutrition**). In addition, doctors often prescribe extra amounts of certain vitamins and minerals for expectant mothers. Weight-losing diets should be avoided except under a doctor's orders. Any chemical in an expectant mother's bloodstream enters the developing baby's bloodstream through the placenta. For this reason, women should not smoke or take unnecessary drugs while they are pregnant.

A woman should continue her normal activities, including proper exercise, during pregnancy. She should also get enough sleep and rest. For more information on this subject, see **Pregnancy**.

Birth

The birth process is called *labor.* A woman is ready to give birth when she feels *labor pains* as the muscles of the uterus begin to contract. The alternate tightening and relaxation of the muscles enlarges the opening from the uterus to the *birth canal,* or *vagina.* As the muscle activity continues, it forces the baby out of the uterus and through the birth canal. Most babies are born head first. The head is bigger around than the rest of the body and so enlarges the opening that leads outside the mother's body. The rest of the baby's body thus passes through the opening easily.

Within a few minutes after birth, a baby starts to cry heartily, which helps the lungs expand and fill with air. The umbilical cord is still attached to the placenta after a baby is born. The doctor clamps and cuts the cord close to the baby's skin. This tiny stump of tissue dries up and falls off within 7 to 10 days, leaving a scar, called the *navel,* on the abdomen.

The muscles of the uterus continue their activity until the placenta separates from the uterus and passes out the birth canal. The discharged placenta is called the *afterbirth.* For additional information, see **Childbirth; Reproduction, Human.**

Growth and development

Two major forces—heredity and environment—influence a baby's growth and development. Heredity determines the characteristics that babies inherit from their parents through the chromosomes. Environment consists of everything with which a baby comes in contact, including the kind of care the baby receives. Environment especially affects the formation of a baby's personality.

A baby's personality begins to develop soon after birth. The development continues throughout childhood and even throughout life. But most experts believe that a person's very early experiences have an especially strong influence on later personality development. For example, infants who never have their needs met when they cry may eventually lie in bed quietly, causing little disturbance. But in time, their emotional, mental, and social growth will fall behind that of other children. Babies who are cared for lovingly—that is, in close and understanding contact with the people who care for them—have the best chances of developing a normal, healthy personality.

Babies differ in the rate and manner of their growth and development. For example, many infants begin to crawl at about 9 to 10 months of age. But some begin to crawl earlier and others later. Still other babies learn to walk without ever crawling.

The first month. A baby is considered a *newborn* for about a month after birth. Newborn babies spend most of their time sleeping.

Characteristics of newborn babies. The average weight for a baby at birth is 7 $\frac{1}{2}$ pounds (3.4 kilograms). The average length of a newborn is 20 inches (50 centimeters). A newborn baby's head makes up about a fourth of the total body length and is bigger around than the chest. The arms are longer than the legs. These proportions change as a child becomes an adult. The head, for example, grows less than the rest of the body and makes up about an eighth of an adult's height.

A newborn baby's skull has six soft spots where the bone is not yet completely joined. These areas become completely covered with bone by about the 18th month. The other bones in a baby's body are only partly *calcified* (hardened with calcium) at birth. These bones calcify gradually throughout childhood.

Most white children have grayish-blue eyes and pink skin at birth. The color of the eyes may change by the fifth or sixth month. This color then becomes permanent. Most black children have brown eyes and relatively light, pinkish skin at birth. The eyes remain brown. The skin begins to darken a few days after birth.

Most of a newborn baby's actions are *reflex* actions—that is, they are completely automatic. Newborn infants can suck and swallow, move their arms and legs, and cry to make their needs known. When lying in bed, they often curl up in a position like the one they had in the womb. If startled by a loud noise or sudden jolt, they jerk their arms and legs in a reflex action called the *startle reflex.* For several months, the baby's neck muscles will not be strong enough to hold the head erect. A person must therefore be careful to support the head while picking up or holding the baby.

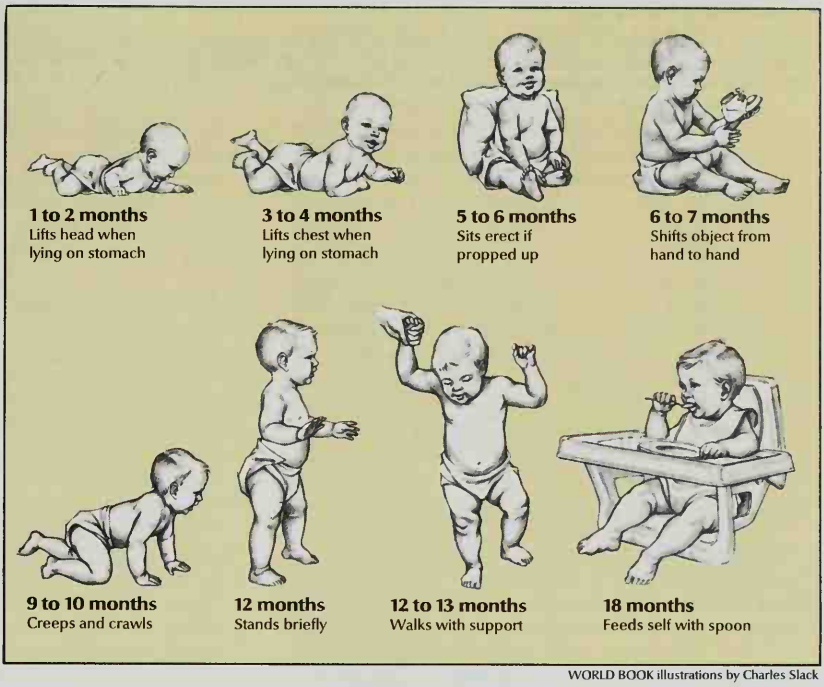
Newborn babies cannot control the movements of their eyes. But they can tell darkness from light and see objects directly in front of them. Newborn babies can also hear, and they quickly learn to recognize their mother's voice.

Feeding and rate of growth. Newborn babies can swallow only liquids. They therefore get their nourishment by sucking milk from their mother's breast or from a bottle. Mothers may begin to *nurse* their babies—that is, feed them milk at the breast—within a few minutes after birth. In most cases, the breasts do not produce a full supply of milk until several days after birth. But babies need little nourishment during this time. Babies who are not breast-fed are given a special *formula* that usually is made from cow's milk. This formula resembles mother's milk and is fed from a bottle with a rubber nipple.

Newborn babies can digest less than 2 ounces (60 milliliters) of mother's milk or formula at a time. As a result, they must be fed often—in most cases, about every four hours day and night. Babies lose weight for a few days

Development of motor skills

These drawings illustrate some of the important *motor skills* (controlled movements) that babies begin to develop about a month after birth. Before that time, their actions are completely automatic. Each drawing gives the age at which most babies develop the particular skill. But some babies develop the skill earlier and others later.



WORLD BOOK illustrations by Charles Slack

after birth because their food intake does not yet meet their needs. But most babies regain the lost weight by about the 10th day after birth. They then begin to gain about 1 ounce (28 grams) a day.

From 1 to 6 months. A baby's growth rate slows after the third month. By the seventh month, the rate will have dropped to about $\frac{1}{2}$ ounce (14 grams) a day. At 5 months, most babies weigh about twice what they weighed at birth.

By the second month, babies have begun to develop various *motor* skills. Motor skills are controlled movements rather than reflex actions. They depend largely on the development of the brain and nerves.

The development of motor skills begins with the head and progresses downward through other parts of the body. Thus, babies learn to move their head and eyes before they can control their arms and legs. By the second month, most infants can turn their head and eyes to follow the movements of people and large objects. By the age of 5 or 6 months, most babies can hold their head erect, grasp objects with their hands, turn themselves over in bed, and sit erect if propped up against something.

Babies first smile and make speechlike sounds at 2 to 3 months of age. To develop normal human relationships, children need a feeling of trust and security. Parents help develop such a feeling in a baby if they treat the baby with love and understanding. Yet parents should avoid being overprotective and not give in to a baby's every demand. Children can thus develop a *frustration tolerance*—that is, the ability to control their feelings when some of their demands are not met.

From 6 to 12 months. Babies achieve a number of "firsts" between 6 and 12 months of age. The first tooth usually appears about the sixth or seventh month. The teeth then continue to grow out at the rate of about one a month until a child has a complete set of 20 *primary,* or *baby,* teeth. Most children have all their primary teeth by about 2 $\frac{1}{2}$ years of age (see **Teeth** [Kinds of teeth]). After they are about 6 months old, babies learn to pick up small objects and pieces of food by clasping them between the thumb and palm. Most babies sit unsupported for the first time by about 7 months. By about 9 months, they may pull themselves to their feet and stand with support.

At about 6 months of age, most babies develop a degree of independence. Their personality then begins to show itself in various ways. For example, they may want to hold their bottle instead of having it held for them. Gradually, every baby develops characteristic ways of doing things, which differ from the ways other babies do the same things. Such differences in behavior indicate the growth of individuality.

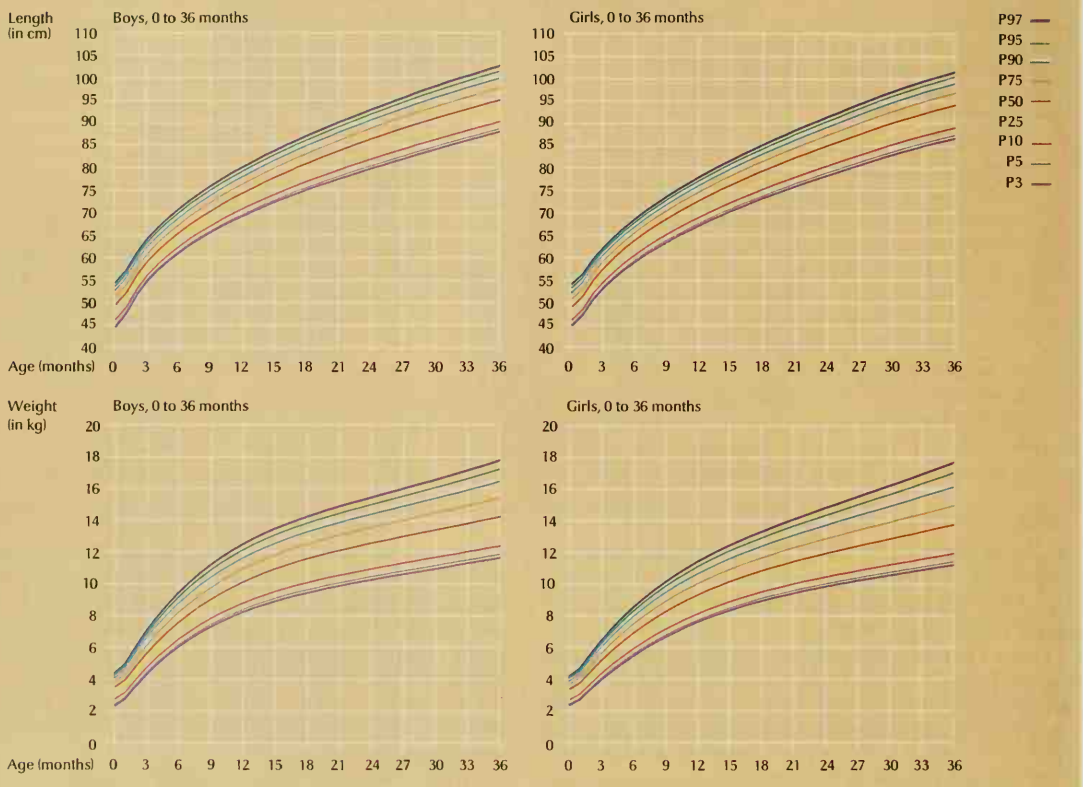
From 12 to 18 months. Babies learn how to do many things by imitating older people. Their ability to imitate improves after they have reached 12 months of age, probably because of a sudden advance in brain and nerve development.

Most infants start to walk with support about the 12th to 13th month. They take their first unaided steps by about 15 months and can run by 18 months. Babies also start to play with blocks, balls, and other objects about the 12th month. At first, they may simply throw the objects or put them in their mouth. But by the 18th month, many infants have learned, for example, to pile a few blocks on top of one another and to push objects along the floor with their hands.

Most babies can say a few words in addition to "Mama" and "Dada" by the age of 12 months. At 15 months, they may "talk" energetically. But they still know few real words. At 18 months, a child's vocabulary may consist of about 10 to 20 words. Many children can also

Growth rates for babies

The charts below represent length-for-age and weight-for-age for boys and girls aged 0 to 36 months. Each colored line represents a *percentile rank* (P). For example, if a baby's length falls on the 75th percentile (P75), that child is taller than 75 percent of the children in that age group.



One centimeter equals 0.39 inch. One kilogram equals 2.2 pounds.
Source: U.S. National Center for Health Statistics.

combine words into phrases at this age.

Babies understand many more words than they use. By 8 or 9 months, most babies respond to the sound of their name. A 1-year-old recognizes the names of a variety of objects and understands "no" and certain other commands. By the age of 15 to 18 months, most babies enjoy listening to simple songs and nursery rhymes. They may also enjoy hearing a story, though the story itself probably means little to them. Most babies this age like to watch television and look at pictures in books and magazines.

Sometime after 18 months of age, a child may be ready for *toilet training*—that is, learning to control the bowels and bladder. But the age when such control becomes possible varies greatly among children. Parents should not force toilet training but wait until a child shows readiness for it.

Baby care

Providing the proper environment. A baby's surroundings should be clean, safe, and cheerful. Room temperatures should be carefully regulated so that a room is neither too warm nor too cool. In addition, babies old enough to move about need room to play. But beyond these simple requirements, physical surroundings alone do little to influence an infant's development. The people responsible for a baby's care—and the attention and stimulation that these people provide—are by far the most important part of the baby's environment.

Babies require much love and affection. They need to be held and soothed when they are disturbed or hurt, and they need to be treated at all times with respect and understanding. Parents help their baby develop a sense of trust and security if they respond to the baby's needs faithfully and confidently. On the other hand, parents who are anxious or nervous may communicate these feelings to a child.

Love also includes discipline—the setting of certain limits on behavior. Children grow up with fewer personal problems if they learn at an early age that some types of behavior are not permitted. Discipline should be firm but just. Harsh discipline may do as much harm

to a baby's development as no discipline at all. A child should never be beaten or shaken.

Feeding procedures. The mother's breast milk is the best food for babies during the first few months after birth. But a milk-derived formula is an acceptable substitute. Babies usually stop feeding when they have had enough. If they take too much milk at a feeding, they will probably spit part of it up. They may also spit up part of a feeding if gas bubbles form in the stomach. To help release the bubbles, the baby should be held upright against the shoulder. The baby's back should be patted firmly, in a practice called *burping*.

Breast-feeding is the natural method of providing milk for a baby. In some countries, it is also the most common method. Mother's milk contains all the nourishment that most babies need. Mother's milk also contains substances that help protect the baby from various diseases and infections. A doctor may prescribe added amounts of certain vitamins and minerals for a breast-fed older infant to ensure an adequate supply.

Bottle-feeding. Homemade or commercially prepared formulas can be substituted for mother's milk. Both types are usually made from pasteurized cow's milk. But cow's milk differs from mother's milk in several ways. For example, it has more protein and less sugar than mother's milk. In preparing the formula, sugar and water are therefore added to cow's milk to make it as much like mother's milk as possible.

Most commercial formulas come ready to use in liquid form. Some commercial formulas come in powdered form. A person simply adds water. But formulas prepared in this way, as well as the bottles and nipples, must be sterilized by boiling. Special soybean formulas are available for babies who have an allergy to milk.

Vitamins and iron. Unlike mother's milk, cow's milk lacks vitamin C. Bottle-fed babies must therefore have vitamin C added to their diet. Mother's milk and cow's milk contain vitamins A and D. But doctors often prescribe extra amounts of these vitamins for both breast-fed and bottle-fed infants to ensure an adequate supply. Doctors may also prescribe added iron in an infant's diet after the first three or four months.

Vitamins are given to a baby in the form of drops or as part of the formula. Many commercially prepared formulas are vitamin enriched. Iron may be given in the form of drops. But it is also present in iron-fortified cereals and in some of the other solid foods a baby may be fed after about the second month.

Solid foods. After 2 to 3 months of age, most babies begin to make chewing motions and improve their ability to swallow. They can then be fed solid foods for the first time. But the food must be soft and mushy so that the baby can chew and swallow it easily. Such foods include cooked cereals and various fruits and vegetables that have been *puréed*. Puréed foods are cooked until soft and then processed in an electric blender or pushed through a strainer or sieve. Such foods may be prepared at home or bought already prepared. To avoid accidents, babies should always be fed with a small spoon rather than with a fork.

By the age of 5 or 6 months, most infants enjoy foods that require more chewing. Although babies have few or no teeth at this age, they can chew with their gums. Many parents add such foods as crackers and puréed meats to the baby's diet at this time. After about 9 months of age, a baby can begin to eat most of the same foods that other family members eat. But the food must be mashed or cut in very small pieces so that the baby will not choke on the food. By the age of 18 months, most babies can feed themselves with a spoon.

Feeding schedules. Most babies require five or six feedings a day until they are about 3 months old. They can then go on four feedings daily. After they are 5 or 6 months old, most babies can go on a schedule of three meals a day with between-meal snacks. But infants differ greatly in how often they need to be fed. Instead of following a strict feeding schedule, many mothers arrange the feedings according to the times when the baby shows signs of being hungry. An infant ordinarily becomes hungry at about the same times every day. Babies may thus establish their own feeding schedule.

Weaning. At about 6 months of age, a baby may be ready for weaning—that is, learning to do without milk from the breast or bottle. Babies differ in their readiness for weaning. Some children do not show a willingness to give up breast- or bottle-feeding until they are 18 months of age or older. A mother should wean her child over a period of several weeks or months. In preparation for weaning, she may encourage the baby to drink milk from a cup. Most babies can learn to drink from a cup by the time they are 6 or 7 months old.

Sleeping conditions. Babies sleep up to 23 hours a day during the first month after birth. Their need for sleep then gradually decreases.

For safety and comfort, a baby should sleep in a specially designed crib. Most cribs have barred sides that can be lowered and raised by an adult. Babies should be kept covered in their crib to avoid chills. Most infants like to lie on their stomach or back with their head turned toward the lightest part of the room.

By about 3 months of age, most infants begin to have a restless, wakeful period each day. They may then squirm and cry a little for exercise. It may help at such

Brent Jones

Spoon-feeding introduces babies to their first solid foods and may begin after about the second month. But milk is a baby's most important food during the first several months after birth.

times to put the baby in a playpen near other members of the family. After a short play period, the baby may be fed, changed, and put back in bed. Parents should not be disturbed if a baby cries for a short while before falling asleep again.

By the age of 18 months, most babies need about 14 hours of sleep daily, including an afternoon nap. Some babies need less sleep than others do and may lie awake for a while during their normal time for sleeping.

Crying usually means that a baby feels hungry, needs a diaper change, or is uncomfortable, tired, or neglected. Babies ordinarily stop crying when the condition is corrected. Feeding, diaper changing, or cuddling is all that an infant needs in most cases. Parents should consult a physician if they cannot find the cause of an infant's crying within a reasonable length of time.

Bathing the baby. Most doctors recommend that a baby not have a tub bath until the stump of the umbilical cord has dried up and fallen off. This process usually takes from 7 to 10 days. Meanwhile, the baby can be given a daily sponge bath with a warm damp cloth.

Babies may have their first tub bath after the navel has healed. For about the first year after birth, they should be bathed in a small tub or basin rather than in a full-sized bathtub. It is much easier to manage babies this age in a small tub than in a large one. They especially need help in keeping their head above water. By about 12 months of age, most infants can control their posture well enough to be bathed in a regular bathtub. Babies should never be left unattended in their bath at any age.

A baby's bathwater should be comfortably warm, not hot. Mild soaps are best for an infant's skin and may be used for washing the scalp as well as the rest of the body. Many parents soap the baby outside the tub and use the tub water for rinsing. The face should be washed without soap to avoid irritation to the eyes.

Babies may be bathed every day or every other day. They need fewer baths during winter than during summer. Washing the diaper area with a warm damp cloth at every diaper change helps prevent rashes.

WORLD BOOK photo by Dan Miller

The first tub bath is usually given about 7 to 10 days after birth, the time required for the navel to heal. Young babies should be bathed in a small tub or basin to prevent accidents.

Clothing the baby. Babies must be dressed warmly enough to avoid chills. But even in cold weather, they need only a few simple kinds of clothing. Many babies are sensitive to wool. They should wear clothes made of cotton or synthetic materials.

Most children have to wear diapers from birth well past the age of 18 months. Some parents use cloth diapers, which must be washed after every use. If parents prefer not to wash diapers themselves, they may subscribe to a commercial diaper service. Such services both supply and launder the diapers. Other parents use disposable diapers, which are thrown away after use. Most disposable diapers are made of absorbent paper lined on the outside with a layer of plastic.

Indoors, a baby needs little more than a diaper and a shirt. If it is cool indoors, the shirt may be replaced with a nightgown or light coverall suit. Newborn infants are often wrapped in a cotton blanket for warmth.

Most babies enjoy being outdoors for a while during the day. An infant's skin burns easily and so should not be exposed to direct sunlight for more than a few minutes. For outdoor wear in cold weather, babies need a cap and such other extra clothing as a sweater and warm coverall suit.

Health care and safety. In many countries, including the United States and Canada, a mysterious disease called *sudden infant death syndrome* (SIDS) ranks as the chief cause of death among infants from 1 to 12 months of age. The disease resembles suffocation. The victims, seemingly healthy children, die suddenly in bed. Scientists are working to find the cause of sudden infant death syndrome.

Less than 100 years ago, diphtheria, measles, and certain other infectious diseases killed many thousands of infants yearly. But since the early 1900's, scientists have developed vaccines that have greatly reduced the number of infant deaths from these diseases.

The Centers for Disease Control and Prevention recommends that all babies be vaccinated against 11 diseases—chickenpox, diphtheria, measles, mumps, polio, rotavirus, rubella, tetanus, whooping cough, meningitis caused by the bacterium *Haemophilus influenzae* type b, and hepatitis B. See **Immunization** for a recommended schedule for receiving these vaccinations.

Accidents in the home cause many injuries and deaths among babies each year. Parents can do much to prevent such accidents. For example, they can help prevent serious burns by keeping babies away from flames and hot stoves. To avoid accidental poisoning, parents should keep medicines, household cleaners, and other chemicals in a cabinet out of a child's reach. Parents should never leave a baby at home alone. Also, they should make sure the baby is secured in a specially designed safety seat when riding in a car. See **Safety** for information about preventing accidents, many of which could endanger a baby.

Duane F. Alexander

Related articles in *World Book* include:

Apgar score
Birth defect
Botulism
Child
Childbirth
Circumcision
Colic
Day care
Developmental psychology
Eugenics

Family
Footprinting
Genetic counseling
Incubator
Infant mortality
La Leche League International
Neonatology
Nutrition
Pediatrics
Pregnancy
Premature birth
Reproduction, Human
Shaken baby syndrome
Sudden infant death syndrome
Teeth
Toy (Toys for infants)

Outline

I. Before birth
A. The developing baby
B. The expectant mother
II. Birth
III. Growth and development
A. The first month
B. From 1 to 6 months
C. From 6 to 12 months
D. From 12 to 18 months
IV. Baby care
A. Providing the proper environment
B. Feeding procedures
C. Sleeping conditions
D. Crying
E. Bathing the baby
F. Clothing the baby
G. Health care and safety

Questions

At what age do babies start to walk with support?
What does a baby's crying usually mean?
Why must babies get their nourishment by sucking milk from their mother's breast or from a bottle?
What can parents do to protect a baby from accidents in the home?
What is an *embryo*? What is a *fetus*?
How many hours a day do babies sleep during the first month after birth?
What are *motor* skills?
Why should a person who picks up or holds a young baby be careful to support the baby's head?
What two major forces influence a baby's growth and development?

Additional resources

Level I

Knight, Margy B. *Welcoming Babies.* Tilbury Hse., 1994.
Manning, Mick, and Granström, Brita. *The World Is Full of Babies!* Delacourt, 1996.

Level II

Brown, Dennis, and Toussaint, P. A. *Mama's Little Baby: The Black Woman's Guide to Pregnancy, Childbirth, and Baby's First Year.* Dutton, 1997.
Caring for You and Your Baby. Fairview Pr., 1997.
Stoppard, Miriam. *The New Parent: The Essential Guide for All First-Time Mothers and Fathers.* Dorling Kindersley, 1998.

Baby boom generation is the large group of people born in the United States from 1946 to 1964. During this period, about 76 million children were born there. By contrast, births totaled about 50 million during the same length of time before the baby boom and about 66 million in the same period after it. The baby boom generation has had major effects on the economy, educational system, and other parts of American life. Its members are called *baby boomers* or *boomers.*

Causes of the baby boom. The baby boom followed the hard times of the Great Depression, which lasted throughout the 1930's; and America's participation in World War II, from December 1941 to August 1945. During this time, many Americans delayed marrying and having children because of the poor economy and the wartime conditions. But the number of marriages and births soared after the war. Many new couples were barely out of their teens. At the same time, numerous older married couples who had delayed having children began to have them when the war ended. Thus, the postwar period featured increased births among both younger and older American couples.

Historically, birth rates have increased for a short period following difficult economic times and wars. However, the increase that began in the United States after World War II continued far beyond the usual time. The economy was a key reason. The 1950's and early 1960's ranked among the most prosperous eras in U.S. history. Many couples felt economically able to support children. The ownership of automobiles and of single-family houses, chiefly in suburbs, soared. These developments encouraged a lifestyle that was favorable to raising children and enjoying family life together.

Effects of the baby boom. The baby boom generation has had major effects on American society because of its size. Because there are so many boomers, businesses have created special advertising and marketing campaigns to gain them as customers. When the baby boomers were young, a "youth culture" in American life emphasized their music, styles and fads, and slang.

The size of the baby boom generation has also led to problems. When the boomers reached school age, schools became overcrowded. Some schools expanded to two shifts a day, and some added temporary structures to accommodate all the pupils. When the boomers reached college age, American higher education had to expand. Larger enrollments, along with inflation and other factors, pushed college costs higher. At times, the baby boomers faced relatively high levels of unemployment because they had to compete with one another for jobs. Their economic prospects have not always been as good as those their parents experienced. Perhaps in response to poorer economic conditions, boomers have tended to delay marriage and to have small families.

The baby boomers will continue to affect American life. For example, when the generation reaches retirement age, its size will put a strain on programs designed to help senior citizens. The chief pension program, the Social Security system, provides money to retired people, using funds contributed by active workers. But without revisions in the system, Social Security's funds will run out when large numbers of boomers begin to retire. For more details, see **Social security** (Developments since 1970).

Teresa A. Sullivan

Babylon, *BAB uh luhn,* was a great city of the ancient world. It was the capital of the kingdom of Babylonia and of two Babylonian empires. Babylon stood on the banks of the Euphrates River near the present-day city of Al Hillah, Iraq. This location helped Babylon become an important trading center. The city also served as the religious center of Babylonia, and the word *Babylon* means *gate of the god.*

The Old Babylonian Empire. Records first mention Babylon about 2200 B.C. King Sumu-abum, the first important Babylonian ruler, founded a *dynasty* (rule by one family) in 1894 B.C. The best-known king of that dynasty was Hammurabi, who ruled from 1792 to 1750 B.C. and won fame for developing a wise and fair code of law. When Hammurabi came to the throne, Babylon was one of several small kingdoms in Mesopotamia. This area, between the Tigris and Euphrates rivers, included what is now eastern Syria, southeastern Turkey, and most of Iraq. Hammurabi conquered all the other kingdoms and established the Old Babylonian Empire.

During Hammurabi's reign, Babylon had several magnificent palaces and temples. Private houses lined the

Detail of an oil painting on canvas (1936) by Maurice Bardin after a water color by Herbert Anger; Oriental Institute, University of Chicago

Babylon, an ancient city on the banks of the Euphrates River, was an important trade center from the 1800's to the 500's B.C. This painting shows the city as it may have looked during the reign of Nebuchadnezzar II from about 605-562 B.C. The city was surrounded by high, decorated walls and had many splendid palaces and temples. The Tower of Babel, *left,* was a terraced pyramid with a shrine on top. It stood in the temple area.

city's narrow, twisting streets. A typical house had a central courtyard surrounded by rooms. A large wall surrounded the city to defend it from invaders. The wall had several gates, and merchants held markets at the gates, trading slaves, food, textiles, building materials, and livestock. Babylonian traders traveled west to Syria and other countries, north to Assyria and south to kingdoms along the Persian Gulf. They often traded textiles and grain for gold, silver, and precious stones.

Babylonian society during Hammurabi's reign had three classes. These classes were citizens, commoners, and slaves. Citizens worked mainly as farmers, merchants, or craftworkers. Little is known about commoners, though they clearly lacked all the rights of citizens. Slaves formed the lowest class. But they could own property, conduct business, borrow money, and even buy their freedom. Free women could own property and had other legal rights. Fathers usually selected husbands for their daughters.

The Old Babylonian Empire lost most of its territory soon after Hammurabi's death. Babylon remained an important political and cultural power, but its rulers did not try to extend its power. The Assyrian Empire took control of Babylon during the 700's B.C. However, the city resisted Assyrian rule, and King Sennacherib of Assyria destroyed Babylon in 689 B.C. Sennacherib's son Esarhaddon rebuilt Babylon 11 years later.

The New Babylonian Empire began in 626 B.C., when the Babylonian military leader Nabopolassar became king of Babylon. Nabopolassar then won control of Babylonia from the Assyrians. Attacks by the Babylonians and their Median allies in 614 and 612 B.C. put an end to the Assyrian Empire. Under Nabopolassar, who reigned until 605 B.C., the New Babylonian Empire controlled much of what is now the Middle East.

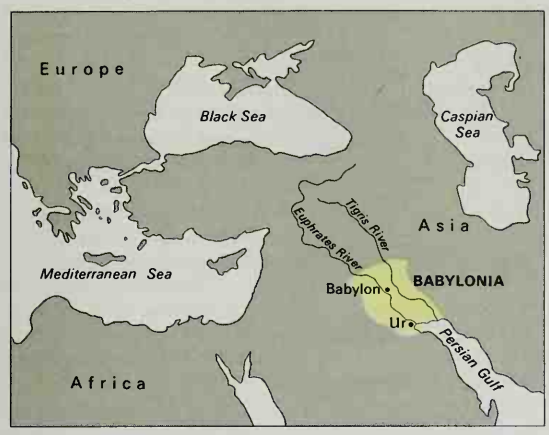
Babylon achieved its greatest glory under the New Babylonian Empire. Nabopolassar and his son Nebuchadnezzar II rebuilt the city on a grand scale. During the reign of Nebuchadnezzar, from 605 to 562 B.C., workers built walls almost 85 feet (26 meters) thick around the outside of Babylon. Huge inner walls protected the city's main section. A wide moat surrounded the inner walls. People entered and left the city through eight bronze gates.

The grandest of these gates, the huge Ishtar Gate, stood on a paved avenue called the *Processional Street.* This street connected the Temple of Marduk inside the walls and the site of a great religious festival outside the city. Babylonians carried statues of the gods along the street during the festival, held at the beginning of each new year. The Ishtar Gate and its walls were decorated with figures of dragons, lions, and bulls made of colored glazed brick.

Nebuchadnezzar's main palace and a fortress stood between the Ishtar Gate and the Euphrates River. This area probably included the city's famous Hanging Gardens. The ancient Greeks described these gardens, which grew on the roof of a high building, as one of the Seven Wonders of the World. A temple area lay to the south. The Temple of Marduk stood there. The area also included the *ziggurat,* a monument that was known in later times as the Tower of Babel (see **Tower of Babel**).

Over 250,000 people may have lived in Babylon and nearby communities. Various agricultural and manufacturing activities flourished in the city. Babylon was the largest business center in the Middle East at that time.

The fall of Babylon. Nebuchadnezzar's successors were unpopular, and the empire became weak. In 539



WORLD BOOK map

Location of Babylonia

B.C., Persian invaders captured Babylon and overthrew the New Babylonian Empire. Babylonia became the wealthiest area in the Persian Empire. In 331 B.C., the Macedonian military leader Alexander the Great gained control of Babylon. He probably planned to make it the capital of his realm. Alexander died in Babylon in 323 B.C. Later, one of his generals, Seleucus, became king of Babylonia and lands around it. Seleucus founded Seleucia, a new capital, on the Tigris River. The people of Babylon later moved to Seleucia. Through the years, the deserted Babylon fell into ruins.

The ruins of Babylon. From A.D. 1899 to 1917, German archaeologists uncovered much of Babylon's ruined palace and temple areas, a residential area, and the city walls. Most of the remains dated from the New Babylonian Empire. Archaeologists have been unable to *excavate* (uncover) remains from the Old Babylonian Empire because the level of water in the ground has risen tremendously since ancient times. This higher *water table* has caused flooding in the deepest holes dug by archaeologists. The government of Iraq has begun to restore a number of structures, including the ziggurat, Nebuchadnezzar's main palace, a temple, the Processional Street, and the city's Greek Theater.

John A. Brinkman

See also **Hammurabi; Nebuchadnezzar II; Semiramis; Sennacherib; Seven Wonders of the Ancient World.**

Babylonia was an ancient region around the Tigris and Euphrates rivers in what is now southeastern Iraq. The region centered around the ancient city of Babylon, which stood about 60 miles (97 kilometers) south of present-day Baghdad, Iraq. A great civilization began in this region about 3500 B.C., and the area was the site of several great empires until the 200's B.C. Babylonia produced the first form of writing, a set of laws, and studies in mathematics, astronomy, and other sciences. Great leaders, such as Hammurabi, Nebuchadnezzar II, Cyrus the Great, and Alexander the Great, were rulers of Babylonia.

Way of life

Babylonian society was divided into various classes at various times. Usually, the *aristocracy* (upper class) included government officials, priests, large landowners, and some traders. The common people were craftworkers, clerks, and farmers. Slaves made up the lowest class.

The Babylonian economy depended chiefly on farming. The king and nobles owned much of the land, and the temples also controlled large areas. The people built networks of canals to carry water from the Tigris and Euphrates rivers to the fields. Landlords maintained the canals on their property, and the use of water was carefully regulated. Babylonian farmers harvested large crops of grain, vegetables, and fruits.

Industry and trade were well developed. The Babylonians exported manufactured goods and perhaps some farm products to all parts of the Middle East. Traders brought back metal, wood, and stone—raw materials which Babylonia lacked. The people began using wheeled carts and chariots about 3500 B.C. The Sumerians, who were the first recorded inhabitants of Babylonia, built huts out of reeds and mud. Because the land had no stone or large trees, the people also used baked or sun-dried bricks for their houses and temples. Some Babylonian temples and palaces included many colorfully decorated rooms and courtyards. The *ziggurats* (temple towers) that stood in the important cities were the most impressive Babylonian buildings. The Babylonians discovered and used many technical devices in erecting buildings. They paid careful attention to drainage, used slightly curved lines in high walls to keep them from appearing top-heavy, and developed mathematical measuring techniques.

Language and literature. About 3500 B.C., the Sumerians began to produce written records in Babylonia. The writing consisted of picturelike symbols scratched on lumps of clay. These symbols later were modified to produce *cuneiform* writing. The use of cuneiform probably lasted until about A.D. 75. See **Cuneiform.**

Archaeologists have found hundreds of thousands of cuneiform tablets in Babylonia and as far away as Egypt. The tablets are in Sumerian and in various dialects of *Akkadian,* the Semitic language of Babylon itself. They include historical and legal documents; letters; economic records; literary and religious texts; and studies in mathematics, astronomy, medicine, and magic.

The Sumerians and Semites kept business records. They produced religious texts giving accounts of rituals, and mythological stories explaining past and present events. Late in the Sumerian period, around 2000 B.C., *scribes* (writers) wrote some law codes.

When the Semites adopted the cuneiform system for their own language, they also borrowed many of the Sumerian stories. But they changed the mythological accounts of creation and of the actions of the gods to fit their own religious system. Most famous of these accounts are the *Creation Story* and the *Epic of Gilgamesh.* The first tells the story of the creation of the world by the god Marduk, patron god of the city of Babylon. The second describes a great flood similar to the story found in the Bible. The Semites also created the set of laws called the *Code of Hammurabi.* The Akkadian-speaking Assyrians wrote about the adventures of kings and their armies after the early Babylonian period.

Mathematical and astronomical texts show that the ancient Babylonians had developed the 360-degree cir-

cle and the 60-minute hour. In addition, the Babylonians understood such concepts as fractions, squares, and square roots. They also could predict eclipses of the sun and moon.

Religion. Babylonians believed that changes in nature and in the fortunes of people were ruled by events that occurred in the heavens among the many gods. On earth, the king reigned as the representative of the gods, especially blessed by them. Babylonian religions combined scientific observation of the sky and the weather, prayer to the various gods who were believed to be in control of these things, and magic. This eventually led to the study of astrology.

Sumerian religion, like Sumerian literary forms, was adopted in part by the Semites. But the Semites emphasized the gods of their own cities rather than earlier Sumerian gods. Babylonians never really rejected earlier gods, however, so the number of gods they worshiped grew into the thousands. There were patron gods and goddesses of each city-state as well as gods representing such things as the sun, moon, and stars, the weather, crops, rivers, and the land.

Art. Making and decorating pottery probably constituted the earliest arts of the Babylonian people. Many broken pieces of early pottery with painted patterns and designs still remain.

By 3000 B.C., the Babylonians had begun carving stones and shells. They began making statues at about the same time. They also produced beautiful jewelry and other art objects in gold and silver. The people sealed jars and documents with stamp seals or cylinder seals, which were engraved with simple designs or religious scenes. The stamp seals were like the rubber hand stamps that are used today. The cylinder seals were rolled in clay while it was wet. The seals often gave the name of the owner or producer of the sealed object. Although no examples remain, Babylonian business records describe elaborate and expensive textiles.

History

The first settlers probably came to Babylonia about 5000 B.C. Historians do not agree on where these people came from.

The Sumerians were among the earliest invaders of Babylonia. They learned to drain the swamps, and to make bricks from mud. They farmed, dug canals, and raised livestock. Craftworkers made objects of clay, stone, bone, wood, and metal.

The Sumerian age of small, independent city-states began about 3000 B.C. and lasted until around 2400 B.C. Such cities as Ur, Uruk, Kish, Umma, and Lagash waged local wars. Each ruled its neighboring areas at times. Umma gained the most power but was conquered along with the rest of Sumer by inhabitants of Babylonia called Semites.

The Semites. A Semitic ruler, Sargon of Akkad, conquered Babylonia during the 2300's B.C. He took his Akkadian army north and west to the Mediterranean Sea and east into Iran. The Akkadians combined Sumerian civilization with their own culture. Sargon's successors held the empire together for more than 60 years, until invaders overran it.

These invaders remained in Babylonia a short time. For about a hundred years, Ur controlled the rest of Sumer. Elamites then invaded, and the disruption they caused helped permit the growth of the first Babylonian Empire.

Babylonian civilization flourished between 1800 and 1600 B.C., under Hammurabi and other kings. Between 626 and 539 B.C., it enjoyed a revival under such kings as Nebuchadnezzar II. The two periods were interrupted by Kassite and Assyrian rule.

Babylonia was part of the Persian Empire from 539 B.C. until Alexander the Great took control in 331 B.C. Soon after Alexander died, Babylonia crumbled.

John A. Brinkman

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Nebuchadnezzar
Numeration systems
Sargon of Akkad
Sennacherib
Sumer
Tigris River
Ur

Additional resources

Foster, Leila M. *The Sumerians.* Watts, 1990. Younger readers.
Oates, Joan. *Babylon.* Rev. ed. Thames & Hudson, 1986.
Rice, Edward. *Babylon, Next to Ninevah: Where the World Began.* Four Winds, 1979. Younger readers.
Saggs, H.W.F. *Babylonians.* Univ. of Okla. Pr., 1995. *The Greatness That Was Babylon.* Rev. ed. St. Martin's, 1991.

Baby's-breath, also spelled *babies'-breath,* is a garden plant grown for its many tiny white flowers. The plants are from 2 to 3 feet (60 to 90 centimeters) tall and have widely branching stems. They are grown in front of shrubbery in rock gardens. Florists mix baby's-breath among the larger flowers in bouquets for a delicate effect. The most common type of baby's-breath is a *perennial,* which lives from year to year. But a few related plants often called baby's-breath are *annuals,* which are grown from seed each year. These plants have rose or pink flowers. Baby's-breath is easy to grow. It is often found in dry, open places. See also **Pink.** W. Dennis Clark

WORLD BOOK illustration by Christabel King

Perennial baby's-breath

Scientific classification. Baby's-breath belongs to the pink family, Caryophyllaceae. The scientific name for the perennial baby's-breath is *Gypsophila paniculata.* The annual is *G. elegans.*

Baca, *BAH kah,* **Elfego,** *ehl FEH goh* (1865-1945), was a Mexican American folk hero. He became known as a fearless lawman in the New Mexico Territory during the late 1800's.

Many white settlers from Texas had moved into the New Mexico Territory. Cultural conflicts between the Texans and the Mexican Americans who already lived

there reached a peak, and violence sometimes occurred. The Texans bullied the Mexican Americans and often robbed or murdered them.

Museum of New Mexico

Elfego Baca

Baca became famous for his part in an incident that occurred in the territorial town of Upper Frisco (now Reserve) in 1884. Baca, who had appointed himself a deputy sheriff, arrested a drunken Texas cowboy for firing gunshots throughout the town. A group of angry Texans attempted to free Baca's prisoner. Baca killed one of the Texans and took refuge in a small hut. Approximately 80 men fired shots into the hut for more than 30 hours, but they did not hit Baca. Baca surrendered to the group only after being promised a fair trial. He was found innocent. Baca later became sheriff of Socorro County.

Baca was born in Socorro. He practiced law in New Mexico from 1894 until his death. Feliciano M. Ribera

Bacchus, *BAK uhs,* was the god of wine in Roman mythology. The myths about Bacchus are almost the same as those involving Dionysus, the Greek god of wine and agricultural fertility. The Romans began to worship Bacchus after they came into contact with Greek culture in the 700's B.C. They also worshiped a wine god called Liber or Liber Pater. But in time, the myths about Liber became almost identical with those about Bacchus.

The Romans held an annual festival honoring Bacchus. This festival, called the *Bacchanalia,* featured drinking and wild behavior. The word *bacchanalian* means drunken or riotous, and *bacchant* means merrymaker. Roman artists showed Bacchus as a handsome young man. But many later artists, especially painters of the Renaissance, portrayed Bacchus as a drunken, fat old man. E. N. Genovese

See also **Dionysus.**

Bach, *bahk,* **Carl Philipp Emanuel** (1714-1788), was a German composer. He was the second oldest son of the famous composer Johann Sebastian Bach. Bach wrote in almost all of the forms of his day except opera. His music had a strong influence on the styles developed later by the Austrian composer Joseph Haydn and the German composer Ludwig van Beethoven. Many of his symphonies, concertos, keyboard sonatas, and chamber works are intense and dramatic. Emotion dominates his most successful vocal works, which include a Magnificat (1749) and the oratorio *The Israelites in the Wilderness* (1769).

Bach was born in Weimar. He was influenced as a young man by the works of his father, but he soon developed a personal style that had much in common with young composers of his day. In 1740, he was appointed harpsichordist at the court of Frederick the Great, king of Prussia. While at the court in Berlin and Potsdam, he became famous for his book *Essay on the True Art of Playing Keyboard Instruments* (first part, 1753; second part, 1762), and for his keyboard compositions. In 1768, Bach became the music director of the five main churches in Hamburg. Darrell Matthews Berg

Bach, *bahk,* **Johann Christian** (1735-1782), a German composer, was the youngest son of the famous composer Johann Sebastian Bach. Johann Christian is best known for his chamber music, symphonies, and operas in the Italian style. He was born in Leipzig, and lived there and in Berlin until he moved to Italy in 1754. From 1762 until his death, he worked in London but made frequent trips to the continent. In London, he became known as "John Christian Bach."

The influence of Bach's international travels on his work is evident in the international operatic and symphonic styles he developed. The Austrian composer Wolfgang Amadeus Mozart was deeply influenced by his combination of northern European and Italian styles. Johann Christian wrote nearly 500 works, 35 of them concertos for harpsichord or piano with orchestra. Using the style of Italian religious music, he composed music for the Roman Catholic Church, to which he had been converted. He also produced concerts and Italian operas in London. Darrell Matthews Berg

Bach, *bahk,* **Johann Sebastian** (1685-1750), a German composer, is considered the greatest genius of baroque music. A highly complex and dramatic style, baroque music reached its peak in the early 1700's. Like most art of the baroque period, baroque music emphasized continual motion. In his compositions, Bach brought such musical techniques as *counterpoint* and *fugue* to their greatest heights. Counterpoint is the playing of two or more melodies at one time. Fugue is a composition in which different instruments repeat the same melody with slight variations. See **Baroque** (Baroque music); **Counterpoint; Fugue.**

Bach's career is one of the wonders of music. In addition to supporting a large family and fulfilling his many duties as a musician and conductor, he wrote hundreds of compositions, including nearly 300 religious and nonreligious choral works called *cantatas.*

His life. Bach was born in Eisenach, Germany, on March 21, 1685. His parents died before he was 10. He then lived with his older brother, who taught him to play the clavichord and harpsichord. Young Bach studied music until 1703, when he joined an orchestra at Weimar as a violinist. He then became an organist, first at the New Church in Arnstadt from 1703 to 1707, and then at the Church of St. Blaise at Mühlhausen in 1707 and 1708. In 1707, he married his cousin Maria Barbara. They had seven children before she died in 1720. Four of his sons also had distinguished careers as composers: Wilhelm Friedemann (1710 -1784), Carl Philipp Emanuel (1714-1788), Johann Christoph Friedrich (1732-1795), and Johann Christian (1735-1782).

Bach apparently was a devoted father, but outside the home he could be short-tempered when faced with incompetence or opposition. In both Arnstadt and Mühlhausen he quarreled with his employers, and he was happy to return to Weimar in 1708.

Bach worked in the court of the Duke of Saxe-Weimar for nine years as court organist and chamber musician. His duties included composing music for religious services and he wrote many church cantatas. He also wrote some of his finest organ works there. But Bach quarreled with the duke and left the court in 1717. From 1717 to 1723, he served Prince Leopold of Anhalt-Cöthen as director of music. The religious services at this court

were simple, and did not require much music. Therefore, Bach could devote himself to composing nonreligious instrumental music.

In 1721, Bach married Anna Magdalena Wilcken, a professional singer. They had 13 children. Bach moved to Leipzig in 1723 and spent the rest of his life there. He became the director of music for St. Thomas's School, which provided music for churches in the city. About 1740, he developed serious eye trouble, and in his last years he was nearly blind. He died of a stroke in 1750.

His works. Bach was a devout Lutheran, and his religious feeling is reflected in his works. With many other baroque composers, he felt almost everything people do and believe is religious. Many of these composers felt baroque music and art helped protect people against the advance of doubt bred by the Renaissance ideas of scientific, rational inquiry. Bach often wrote *I.N.J.,* for the Latin words meaning *In the Name of Jesus,* on the manuscripts of even his nonreligious works.

New York Public Library

Johann Sebastian Bach

The people of Bach's time appreciated him as an organist, but generally ignored his compositions. His complete works fill about 60 volumes, but only 9 or 10 of his compositions were published during his lifetime. The people of his time considered his complex baroque compositions too elaborate. Instead, they preferred a simpler, more lively style. His reputation as a composer was not firmly established until 1829, when the German composer Felix Mendelssohn revived his "Passion According to St. Matthew."

Bach did not concern himself with writing much on musical theory, and did not experiment with or originate new forms. He composed in almost all of the musical forms of his day except opera. His skill covered the widest range of musical combinations—dramatic and intimate, and from the most complex counterpoint to the simplest chords. He always tried to convey meaning and avoid mere showiness. He used a kind of musical shorthand in his works, in which the chords formed from the bass part were indicated by figures. This is called *figured bass* or, in Italian, *basso continuo.*

Bach carefully based each movement of his work on a characteristic mood such as joy, and tended to maintain the mood more consistently than later composers, including Beethoven. Bach's love of counterpoint influenced the most simple and most complex of his pieces. He frequently restated a melody by *imitation,* repeating it in a higher or lower voice than in the original melody. Bach also used a constant unit of rhythm through a given movement. His works mixed the national music styles of his day, chiefly French, Italian, British, and German.

Bach was convinced that through his music he could serve his church, his community, his principality, or his patron. As a result, his works not only provided enjoyment for listeners, but they also had instructional value for the musicians who performed them. The choirs that performed his works were small, usually about 12 people, some of whom sang solo parts. The instrumental ensembles he used were also small. Thus Bach concentrated on creating a sense of spiritual, rather than physical, bigness.

Bach's work can be divided into five periods. Each has special characteristics that resulted in part from his duties in the musical post he filled.

The First Period (1703-1708) consists of works written in Arnstadt and Mühlhausen. These somewhat loosely organized works show the influence of the composer Dietrich Buxtehude (see **Buxtehude, Dietrich**). Bach's cantata *Gottes Zeit,* intended to be performed at funerals, is a strong, expressive work of this period.

The Second Period (1708-1717) consists of works composed at Weimar. There, Bach wrote many brilliant organ works and several cantatas in the northern European style. But some of his works reflect the concentrated clarity of the Italian style. Bach's famous *Toccata and Fugue in D minor* was written during this period.

The Third Period (1717-1723) consists of works written at Anhalt-Cöthen. Most are instrumental compositions, written for solo or *ensemble* (group) performance. Bach completed Book I of the *Well-Tempered Clavier* in 1722. Book I and Book II (completed in 1744) each have 24 preludes and fugues, written in each of the 12 major and 12 minor keys. He incorporated more Lutheran hymns into his works, as in the set of organ chorale preludes called the *Little Organ Book.*

Bach completed the six *Brandenburg Concertos* in 1721, and dedicated them to the ruler of the province of Brandenburg. He also wrote four *Orchestral Suites,* or *Overtures,* six sonatas and partitas for solo violin, and six suites for solo cello. He wrote *French Suites* for the harpsichord. His arrangements of his own or Italian composer Antonio Vivaldi's solo violin concertos for keyboard instead of violin with orchestra show his growing ability to use counterpoint to increase the substance and texture of such works.

The Fourth Period (1723-1745) consists of works written at Leipzig. These are principally works for chorus and orchestra, but also include significant collections of solo instrumental works. His cantatas of this period show more organization than his earlier works.

Bach's great sense of telling a story dramatically without stage properties or settings is demonstrated in the form and imaginative breadth of *The Passion According to St. John* (1723) and *The Passion According to St. Matthew* (1729). In these, Bach relied on a narrative story more than he did in his sacred cantatas. Even the *Christmas Oratorio,* a series of six cantatas written in 1734, is more a series of Christmas meditations than a narration of the Christmas story. Bach's secular cantatas, including the *Coffee Cantata,* depended more on plot narration than did the religious cantatas. Bach often illustrated episodes by using melodies or chords to describe an event like the crowing of a cock or a physical or spiritual occurrence like an ascent into heaven.

Bach's *Mass in B minor* adapted certain operalike forms to religious purposes, expressing a universal idea of Christianity. A close relationship between worship and musical study also can be seen in Bach's *Keyboard Practice,* which includes his *Concerto in the Italian Style;* the monumental *Aria with 30 Variations,* known as the

Goldberg Variations; and six partitas for harpsichord.

Bach showed astonishing ability to carry to maturity compositional types he treated in his earlier years. He composed the *Mass in B minor* about 15 years after he wrote the splendid *Magnificat* (1723). Book II of the *Well-Tempered Clavier* presented in a less unified form the systematic succession of keys found in Book I. He also composed his concertos for one, two, three, or four harpsichords during this period. Most of these works are arrangements of earlier concertos for melody instruments with orchestral accompaniment.

The Fifth Period consists of works from Bach's last five years. These compositions display strong unity of organization and were usually based on one melody. The major works include *Canonic Variations on a chorale "Von Himmel hoch," Musical Offering,* and *The Art of Fugue.* This last work, left unfinished, contains 18 individual sections arranged in progressively greater complexity, but all based on one melodic line.

Darrell Matthews Berg

See also **Cantata; Passion music; Vivaldi, Antonio.**

Additional resources

Bach Perspectives. Univ. of Neb. Pr., 1995-. Multivolume work.
Bettmann, Otto L. *Johann Sebastian Bach as His World Knew Him.* Birch Lane, 1995.
Marshall, Robert L. *The Music of Johann Sebastian Bach.* Schirmer Bks., 1989.
Wolff, Christoph. *Bach: Essays on His Life and Music.* Harvard Univ. Pr., 1991.

Bachelor's-button is a plant that bears small flowers shaped like buttons. Usually the flowers are blue, but some varieties have pink, purple, or white blossoms. The flowers measure 1 to 1 $\frac{1}{2}$ inches (2.5 to 3.8 centimeters) across. Bachelor's-buttons are *annual* plants—that is, they live for only one year. The plant, which blooms from June to September, grows up to 2 feet (60 centimeters) tall and has long, narrow leaves. White, cottony hairs cover the leaves and young stems of the plant. Bachelor's-buttons are also called *cornflowers* or *bluebottles.*

The bachelor's-button originally grew wild in Europe, north of the Mediterranean Sea, but it has spread to many areas of the world. The bachelor's-button is a hardy plant that can easily be grown in the garden. In spring, new plants may sprout from seeds dropped by the previous year's plants. Margaret R. Bolick

Scientific classification. The bachelor's-button belongs to the composite family, Compositae. Its scientific name is *Centaurea cyanus.*

See also **Flower** (Garden annuals [picture]).

Bachelor's degree. See **Degree, College.**

Back is the part of the body that extends from the neck to the *buttocks* (rump). Its sides are formed by the ribs, which are attached to the *vertebrae* (bones that make up the spine). The *scapulae* are the shoulder blades below the neck and to either side of the spine. The *pelvis* (framework of bones of the lower trunk of the body) forms the base of the back. See **Pelvis.**

The back has many groups of muscles that perform different tasks. The *postvertebral* (behind the vertebrae) muscles hold the body erect and allow the back to be extended. The *sacrospinalis* muscles link the vertebrae and the pelvis. The *trapezius, latissimus dorsi, levator scapulae,* and *rhomboidei* muscles hold and *manipulate* (operate) the upper arm and scapulae.

Many people suffer from backaches (see **Backache**). Sometimes the *intervertebral disk,* the tissue that lies between the vertebrae, *protrudes* (sticks out) and presses on nerves. This condition is called a *slipped disk,* or *herniated disk.* It can cause severe pain in the lower back, thighs, and legs. James A. Hill

See also **Human body** (Trans-Vision).

Back swimmer. See **Water bug.**

Backache is a pain that originates in the area of the spine. It is a common disorder that most frequently affects the lower back but can involve any area of the spinal column. Backache is not a disease but rather a symptom of some condition. Most commonly, backache results from muscular strain, overactivity, or stress. It may, however, be a sign of a more serious condition. Disorders of the spine, including infections, fractures, and ruptured disks, may produce back pain. Back pain associated with pain, numbness, or weakness of the leg or arm is usually the result of nerve damage. Other disorders, such as tumors, infections, kidney disease, and disorders of the pancreas, also can produce backache. See also **Repetitive strain injury.** Leslie S. Matthews

Backbone. See **Vertebrate; Spine.**

Backgammon, *BAK gam uhn,* is a game for two people played with a rectangular board and dice. The board is divided into halves by a vertical *bar.* One half of the board is the *inner table,* or *inner board.* The other half is the *outer table,* or *outer board.* The half of the inner table nearest the player is called the *home board.*

A backgammon board has 24 spear-shaped divisions called *points* grouped into 4 sections of 6 points each. Players begin the game by placing 15 dark or light *men* (checkers) on their starting points. Players move their men from point to point by throwing two dice from a cup. A man may not land on a point containing two or more opposing men. If a man lands on a single opposing man, that opposing man is placed on the bar. A man on the bar must be reentered, in the opponent's home table, before any other men of the same color can be moved. When all the player's men are in the home table, the player may begin to remove them from the board. The first player to move all 15 men off the board wins.

R. Wayne Schmittberger

WORLD BOOK photo by Cameramann International, Ltd.

Backgammon is a dice game played on a board.

Bacon is a kind of meat that is obtained from the sides or bellies of hogs. The meat is cured and smoked to provide its distinctive flavor. People often serve thin strips of fried bacon with eggs for breakfast or on sandwiches for lunch. Pieces of crisp bacon are used to add flavor to salads and other foods. *Canadian bacon* is made from the loin muscles on the sides of a hog's back. This bacon is leaner than regular bacon.

Pork to be made into bacon is cured with salt, sodium nitrite or potassium nitrite, sodium phosphate, and sugar. Salt and sugar flavor the meat, and sodium phosphate helps it retain moisture. Salt and nitrite help preserve the meat, and nitrite gives the meat a reddish-pink color. Nitrite prevents *botulism,* a kind of food poisoning that may occur in cured meat. Under certain conditions, nitrite may combine with other chemicals to form compounds called *nitrosamines.* Experiments have shown that nitrosamines can cause cancer in laboratory animals. For this reason, the U.S. Department of Agriculture limits the amount of nitrite allowed in bacon and other cured meats.

Meat packers cure most bacon by the *injection method.* In this process, which takes from one to three days, the curing ingredients are dissolved in water and injected into the meat. The bacon is then cooked and smoked in a large oven. Smoke from burning hardwood or in concentrated liquid form is added to give the bacon a smoky aroma and flavor. Donald H. Beermann

Bacon, Francis (1561-1626), was an English philosopher, essayist, jurist, and statesman. He was one of the earliest and most influential supporters of *empirical* (experimental) science and helped develop the scientific method of solving problems.

Bacon's principal philosophical writings are *The Advancement of Learning* (1605) and *Novum Organum* (*New Instrument,* 1620). These were the only books that he completed of a planned six-part project called *Instauratio Magna* (*Great Renewal*). He intended this work to be a survey of all learning to his time. Bacon wanted *Great Renewal* to lay a new foundation upon which the whole structure of all knowledge could be soundly built. He also wrote witty and original essays.

His life. Bacon was born in London, the son of an important councilor to Queen Elizabeth I. In 1584, he was elected to Parliament. Bacon held several government positions, notably lord chancellor. In 1621, Bacon was convicted of taking bribes and imprisoned briefly. Later evidence indicated he was not influenced by bribery. But he withdrew from public life and devoted the last five years of his life to study and writing.

His philosophy. Bacon believed all previous claims to knowledge, particularly of medieval science, were doubtful because they were based on poor logic. He believed the mind makes hasty generalizations, which prevent the attainment of knowledge. But he also believed that the mind could discover truths that would enable humanity to conquer disease, poverty, and war by gaining power over nature. To discover truths, the human mind must rid itself of four prejudices. Bacon called these prejudices *Idols of the Mind.*

Detail of an oil portrait from the studio of Paulus van Somer, National Portrait Gallery, London

Francis Bacon

The first Idol (of the Tribe) is the tendency of general human perception to generalize too quickly. Bacon claimed that uncritical perception cannot be trusted. The second Idol (of the Cave) is the tendency of people to base a knowledge of things on individual experiences, education, and tastes. People fail to realize how variable and untrustworthy these factors can be as a basis for claims to knowledge. The third Idol (of the Market Place) results from the dependence on language to communicate. Because words are often imprecise, they may be misinterpreted. The fourth Idol (of the Theater) is the influence of previous philosophies and laws of reasoning that are merely products of imagination.

Bacon believed the mind could attain truth if it followed the *inductive method* of investigation. He developed four steps of doing so: (1) listing all known cases in which a phenomenon occurs; (2) listing similar cases where the phenomenon does not occur; (3) listing the cases in which the phenomenon occurs in differing degrees; and (4) examination of the three lists. These steps would lead to the cause of a phenomenon.

Bacon suggested the use of preliminary *hypotheses* (assumptions) to aid scientific investigation. His treatment of hypothesis is still a subject of study. Bacon also wrote an unfinished romance called *New Atlantis* (published in 1627, after his death). The book describes an imaginary island where the inhabitants dedicate themselves to the study of science. Craig Walton

See also **Age of Reason** (Influence of the Age of Reason); **Empiricism; Essay** (Formal essays); **Philosophy** (Modern philosophy); **Science** (The scientific revolution).

Additional resources

Peltonen, Markku, ed. *The Cambridge Companion to Bacon.* Cambridge, 1996.
Sessions, William A. *Francis Bacon Revisited.* Twayne, 1996.
Zagorin, Perez. *Francis Bacon.* Princeton, 1998.

Bacon, Francis (1909-1992), was an important British artist. Many of Bacon's paintings portray deformed and tormented figures isolated in desolate interiors. One series of paintings shows people screaming in hysteria. Some of his works are derived from traditional art, such as *Study After Velázquez: Portrait of Pope Innocent X.* Other subjects are related to newspaper and magazine photographs of current events. Bacon also painted portraits of his friends and of himself. Many works are grouped in sets of three images called *triptychs,* presenting different aspects of the same experience.

Bacon was born in Dublin, Ireland. He had almost no formal education. Pamela A. Ivinski

Bacon, Nathaniel (1647-1676), was a leader of Bacon's Rebellion in Virginia. When Governor William Berkeley failed to take quick action in 1676 to repel an Indian invasion, some Virginia planters chose Bacon to lead a force against the Indians. After Bacon's force defeated the Indians, he attempted to make the governor reform colonial policies. Bacon led an army that captured and burned Jamestown. He controlled the colony briefly in 1676. His death ended the rebellion.

Bacon was born in Suffolk, England, and was educated at Cambridge University. He came to Virginia in 1673.

T. H. Breen

See also **Bacon's Rebellion; Berkeley, Sir William.**

Bacon, Roger (1214?-1292?), was an English philosopher and scientist. He ranks as one of the leading figures in the development of science during the Middle Ages. Bacon became known as a founder of experimental science and one of the early researchers in the study of optics, the branch of physics that studies light. He helped lay the foundation for the revolution in science that occurred in Europe in the 1500's and 1600's.

His life. Bacon was born in the county of Somerset and studied liberal arts and philosophy at Oxford University. He left Oxford during the 1230's and began to teach at the University of Paris. About 1247, he gave up teaching because of ill health and returned to Oxford. He spent the next 10 years in the intensive study of mathematics, technology, and especially optics.

About 1257, Bacon joined the Franciscan religious order. He returned to Paris to urge educational reform within the church and to devote himself to discovering and spreading a system of all knowledge. At about this time, however, a dispute within the Franciscan order resulted in the introduction of censorship. Bacon's superiors allowed him to continue writing, but they prohibited him from publicizing his work.

At the request of Pope Clement IV, Bacon compiled a summary of his system of knowledge. He sent the summary, called the *Opus maius* (*Longer Work*), to the pope in 1267. This summary became Bacon's most significant work.

During the 1270's, Bacon wrote on astronomy, mathematics, and physics. In 1278, the church criticized some of his writings, and he was imprisoned in a Paris convent until 1292. Shortly before his death, Bacon finished his *Compendium of Theological Studies.* In it, he denounced what he considered the evils of the Christian world.

His work. Bacon's major achievements came in science, but he also wrote on philosophy and theology. These works show the influence of the Greek philosopher Aristotle, the Christian theologian Saint Augustine, and the Muslim philosopher Avicenna.

In the *Opus maius,* Bacon urged the study of languages, especially Arabic, Greek, and Hebrew. He believed such study would enable scholars to improve their interpretation of the Bible and to discover more about Arabic and Greek scientific knowledge. Bacon considered mathematics the key to any scientific investigation, especially in astronomy.

Bacon demonstrated the usefulness and interdependence of mathematics and scientific experiments in optics, his primary field of study. He used the *inductive method* to study the formation of rainbows (see **Inductive method**). Bacon also described the exact anatomy of the eye and the optic nerves.

William J. Courtenay

See also **Airplane** (Early experiments and ideas).

Additional resources

Easton, Stewart C. *Roger Bacon and His Search for a Universal Science.* 1952. Reprint. Greenwood, 1970.

Hackett, Jeremiah, ed. *Roger Bacon and the Sciences.* Brill, 1997.

Westacott, Evalyn. *Roger Bacon in Life and Legend.* 1953. Reprint. Norwood Editions, 1978.

Bacon's Rebellion was a revolt of Virginia colonists against the colony's English government in 1676. The uprising was headed by Nathaniel Bacon, a prosperous young planter. The colonists charged that Governor William Berkeley would do nothing to stop Indian raids on the western settlements. The colonists also claimed that Berkeley granted political and commercial favors to his friends. Berkeley claimed, with some justice, that western Virginians killed Indians to obtain more land.

A group of colonists asked Bacon to lead an expedition against the Indians. After doing so, he and his followers made Governor Berkeley call an assembly to grant general political reforms. Later, Governor Berkeley called Bacon a rebel, and Bacon and his followers returned to burn Jamestown. Bacon died that year, but his rebellion led to the removal of Berkeley and to colonial reforms. Some historians dispute the charges against Berkeley.

T. H. Breen

See also **Bacon, Nathaniel; Berkeley, Sir William.**

Bacteria are simple organisms that consist of one cell. They are among the smallest living things. Most bacteria measure from 0.3 to 2.0 *microns* in diameter and can be seen only through a microscope. (One micron equals 0.001 millimeter or $\frac{1}{25,400}$ inch.) Scientists classify bacteria as *prokaryotes* (see **Prokaryote**).

Bacteria exist almost everywhere. There are thousands of kinds of bacteria, most of which are harmless to human beings. Large numbers of bacteria live in the human body but cause no harm. Some species cause diseases, but many others are helpful.

The importance of bacteria

Helpful bacteria. Certain kinds of bacteria live in the intestines of human beings and other animals. These bacteria help in digestion and in destroying harmful organisms. Intestinal bacteria also produce some vitamins needed by the body.

Bacteria in soil and water play a vital role in recycling carbon, nitrogen, sulfur, and other chemical elements used by living things. Many bacteria help *decompose* (break down) dead organisms and animal wastes into chemical elements. Other bacteria help change chemical elements into forms that can be used by plants and animals. For example, certain kinds of bacteria convert nitrogen in the air and soil into nitrogen compounds that can be used by plants (see **Nitrogen cycle**).

A chemical process called *fermentation,* used in making alcoholic beverages and cheese and many other foods, is caused by various bacteria. Sewage treatment plants use bacteria to purify water. Bacteria are also used in making some drugs.

Bacterial cells resemble the cells of other living things in many ways, and so scientists study bacteria to learn about more complex organisms. For example, the study of bacteria has helped researchers understand how certain characteristics are inherited. Most types of bacteria reproduce quickly. This rapid reproduction enables scientists to grow large quantities for research.

Harmful bacteria. Some species of bacteria cause diseases in human beings. These diseases include cholera, gonorrhea, leprosy (Hansen's disease), pneumonia, syphilis, tuberculosis, typhoid fever, and whooping cough. The bacteria enter a human being's body through its natural openings, such as the nose or

mouth, or through breaks in the skin. In addition, air, food, and water carry bacteria from one person to another. Harmful bacteria prevent the body from functioning properly by destroying healthy cells.

Certain bacteria produce *toxins* (poisons), which cause such diseases as diphtheria, scarlet fever, and tetanus. Some toxins are produced by living bacteria, but others are released only after a bacterium dies. A form of food poisoning called *botulism* is caused by toxins from bacteria in improperly canned foods.

Bacteria that usually live harmlessly in the body may cause infections when a person's resistance to disease is low. For example, if bacteria in the throat reproduce faster than the body can dispose of them, a person may get a sore throat.

Bacteria also cause diseases in other animals and in plants. *Anthrax* is a bacterial disease that infects many animals, especially cattle and sheep. Plant diseases caused by bacteria include *fire blight,* which occurs in apple and pear trees, and *soft rot,* which decays some fruits and vegetables. Bacteria also cause growths called *crown galls,* which attack various plants.

Protection against harmful bacteria. Many bacteria live on the skin and in the mouth, intestines, and breathing passages. But the rest of the body tissues are normally free of bacteria. The skin, and the membranes that line the digestive and respiratory systems, prevent most harmful bacteria from entering the rest of the body. When harmful bacteria do enter the body, white blood cells surround and attack them. Also, the blood produces *antibodies,* substances that kill or weaken the invaders. Toxins are neutralized by certain antibodies called *antitoxins.* Sometimes the body cannot make its own antitoxins fast enough. In such cases, a physician may inject an antitoxin from an animal, such as a horse or rabbit, or from another person.

Dead or weakened bacteria are used in making drugs called *vaccines,* which can prevent the diseases caused by those species of bacteria. Vaccines are injected into the body, causing the blood to produce antibodies that attack the bacteria. Some vaccines protect the body from infection for several years or longer. Drugs called *antibiotics* are made from microorganisms that inhabit the air, soil, and water. Antibiotics can kill or weaken disease-causing bacteria. However, extensive use of antibiotics may encourage the spread of bacteria resistant to the drugs. The drugs then become ineffective.

People use chemicals called *antiseptics* to prevent bacteria from growing on living tissues. Other chemicals, known as *disinfectants,* are used to destroy bacteria in water and on such items as clothing and utensils. Bacteria can also be killed by heat, and so heat is often used to sterilize food and utensils.

The structure of bacteria

Nearly all kinds of bacteria are enclosed by a tough protective layer called a *cell wall.* The cell wall gives the bacterium its shape and enables it to live in a wide range of environments. Some species are further enclosed by a *capsule,* a slimy layer outside the cell wall. The capsule makes the cell resistant to destructive chemicals. All bacteria have a *cell membrane,* an elastic, baglike structure just inside the cell wall. Small molecules of food enter the cell through pores in this membrane, but large molecules cannot pass through. Inside the membrane is the *cytoplasm,* a soft, jellylike substance. The cytoplasm contains chemicals called *enzymes,* which help break down food and build cell parts.

Like the cells of all living things, bacterial cells contain *DNA* (deoxyribonucleic acid). DNA controls a cell's growth, reproduction, and all other activities. The DNA of a bacterial cell forms an area of the cytoplasm called the *nucleoid.* In all other organisms except *cyanobacteria* (blue-green algae), the DNA is in the *nucleus,* a part of the cell separated from the cytoplasm by a membrane.

Scientists generally divide bacteria into groups according to shape. Round bacteria are called *cocci,* and rod-shaped ones are *bacilli.* Bacteria that look like bent rods are *vibrios.* There are two types of spiral-shaped bacteria, *spirilla* and *spirochetes.* Two or more bacteria linked together may be described by the prefixes *diplo-* (pair), *staphylo-* (cluster), or *strepto-* (chain). For example, *streptococci* are a type of round bacteria linked together in chains.

The life of bacteria

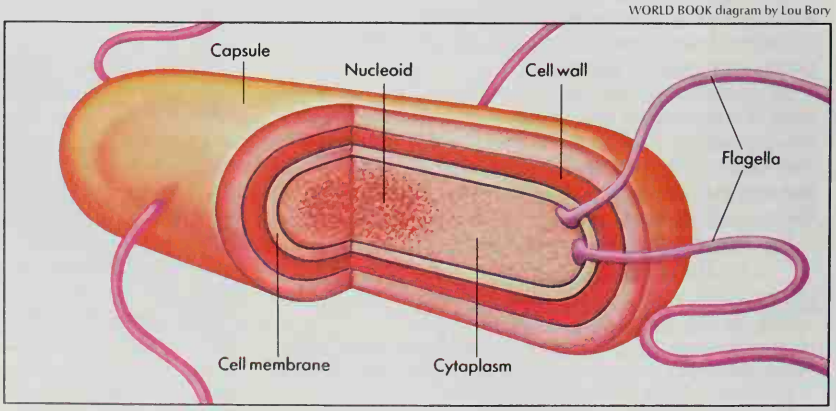
Where bacteria live. Bacteria live almost everywhere, even in places where other forms of life cannot survive. The air, water, and upper layers of soil contain many bacteria. Bacteria are always present in the digestive and respiratory systems and on the skin of human beings and other animals.

Certain bacteria, called *aerobes,* require oxygen to

A bacterial cell

A bacterial cell may have up to three protective layers. These layers surround the cytoplasm, which contains the cell's nucleoid. Hairlike flagella extend through the layers in many types of bacteria. The flagella help the bacterium to move by means of a whiplike motion.

WORLD BOOK diagram by Lou Bory

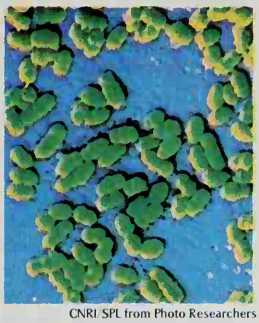


Some basic kinds of bacteria

Scientists classify bacteria according to shape. Cocci are round and some are linked together. Bacilli look like rods, and vibrios resemble bent rods. There are two types of spiral-shaped bacteria, spirochetes and spirilla.

CNRI/SPL from Photo Researchers

Cocci



CNRI/SPL from Photo Researchers

Bacilli

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Vibrios

Eric Grave, Photo Researchers

Spirochetes

live, but others, known as *anaerobes,* can survive without it. Some anaerobes can exist either with or without oxygen. Other anaerobes cannot live with even a trace of oxygen in their environment.

Some bacteria protect themselves against a lack of food, oxygen, or water by forming a new, thicker cell membrane inside the old one. The cell material surrounding the new membrane dies. The remaining organism becomes inactive and is called a *bacterial spore.* Bacterial spores may live for decades or even longer because they can resist extremely high or low temperatures and other harsh conditions. If food, oxygen, and water again become available, the spores change back into active bacteria.

How bacteria move. Bacteria are carried long distances by air and water currents. Clothing, utensils, and other objects also carry bacteria. Various kinds of bacteria have *flagella* (thin hairs) that enable them to swim. Some species that lack flagella move by wriggling.

How bacteria obtain food. Most kinds of bacteria, called *heterotrophic bacteria,* feed on other organisms. Some species, known as *autotrophic bacteria,* manufacture their own food. For example, *photosynthetic bacteria* make food from carbon dioxide, sunlight, and water. Certain bacteria may be autotrophic or heterotrophic, depending on the food available. The majority of heterotrophic bacteria feed on dead organisms. Others are parasites. Some parasitic bacteria cause little or no harm to the host organism, but others cause diseases.

CNRI/Science Photo Library from Photo Researchers

Binary fission occurs when a bacterium divides into two cells, each of which is identical to the original one.

How bacteria reproduce. Most bacteria reproduce *asexually*—that is, each cell simply divides into two identical cells by a process called *binary fission.* Most bacteria also reproduce quickly, and some species double their number every 20 minutes. If one of these cells were given enough food, over a billion bacteria would be produced in 10 hours. Industrial and laboratory processes often produce such enormous numbers of bacteria. But in nature, bacteria lack an adequate food supply to maintain such a high rate of reproduction.

When bacteria reproduce by binary fission, the DNA in each of the two resulting cells is identical to the DNA in the original bacterium. Some bacteria can exchange DNA by a kind of simple sexual process called *conjugation.* Conjugation involves the direct transfer of DNA from one type of bacterial cell, called a *male,* to another type, called a *female.* DNA also may be transferred by viruses. Bacteria also may pick up fragments of DNA from dead bacterial cells. By transferring DNA, bacterial cells transfer individual traits. For example, bacterial cells that are resistant to certain antibiotics may transfer this characteristic to nonresistant bacterial cells.

Scientists have developed techniques that allow them to isolate fragments of DNA responsible for particular traits. Inserting these fragments into different bacteria, called *recombinant DNA technology,* produces useful new kinds of bacteria. For example, some of these bacteria chemically break down oil and also help clean up oil spills. Others are used to make substances with medical applications, such as insulin (see **Insulin**).

History

The first living things on the earth probably included simple forms of bacteria. The oldest known fossils are those of bacteria that lived about $3\frac{1}{2}$ billion years ago. Some scientists believe certain bacteria gradually developed into multicelled organisms that were the ancestors of the more complex plants and animals of today.

Bacteria were first described in the mid-1670's by Anton van Leeuwenhoek, a Dutch amateur scientist. For many years, scientists believed that bacteria came from nonliving matter. But in the late 1800's, the French chemist Louis Pasteur showed that only living things can

produce living things. Pasteur and Robert Koch, a German physician, helped develop the science of bacteriology (the study of bacteria). See **Bacteriology.**

David Schlessinger

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Some bacterial diseases

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Scarlet fever
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Magnetism (Magnets in living things)
Nitrogen cycle
Rickettsia
Quinolone
Staphylococcus
Sterilization
Streptococcus
Virus

Additional resources

Facklam, Howard and Margery. *Bacteria.* 21st Century Bks., 1994. Younger readers.

Sankaran, Neeraja. *Microbes and People: An A-Z of Microorganisms in Our Lives.* Oryx, 2000.

Tierno, Philip M., Jr. *The Secret Life of Germs.* Pocket Bks., 2001.

Bacteriological warfare. See Chemical-biological-radiological warfare.

Bacteriology, *bak TIHR ee AHL uh jee,* is the study of single-celled organisms called bacteria. Some kinds of bacteria cause serious diseases, such as leprosy and tuberculosis. But other kinds are helpful. For example, some bacteria keep our environment clean by helping dead organisms decay. Bacteriologists study harmful bacteria to determine the exact way they cause disease so that better vaccines can be developed. They study helpful bacteria to learn to use and control them.

Studying bacteria. To establish that a certain bacterium causes a particular disease, bacteriologists follow four basic steps. These steps are called *Koch's postulates,* after the German physician Robert Koch, who formulated them in the late 1800's. The steps are: (1) *Pathogenic* (disease-causing) bacteria are taken from diseased animals. (2) The pathogenic bacteria are isolated and grown in a laboratory. (3) The laboratory-grown bacteria are injected into experimental animals. (4) Bacteria are isolated from the diseased experimental animals and shown to be the same kind as the original bacteria.

Bacteria grown in a laboratory must have a constant supply of food for growth. Bacteriologists must also be able to grow one particular *strain* (variety) of bacteria at a time. Substances used for growing bacteria in the laboratory are called *culture media.* A common ingredient of a culture medium is *agar,* which is obtained from the stems of certain seaweeds. Agar dissolves in boiling water and then forms a *gel* (jellylike substance) when cooled to about 40 °C (104 °F). Such food substances as blood, meat extract, peptones, salt, and sugar are added to agar for growing bacteria. Individual bacteria can be deposited on solidified agar by streaking it with materials containing bacteria. Millions of bacteria of a single type may then grow from each bacterium.

After a particular strain of bacteria has been isolated and grown, bacteriologists place some of the bacteria on a glass slide and study them under a microscope. They may also apply certain stains to the bacteria on the slide so they can be more easily seen and identified. If the bacteriologists want to study the interior of a single bacterium, they may prepare a sample from a culture to study under an electron microscope.

Controlling bacterial diseases. Many bacterial diseases can be prevented by vaccines. Vaccines are made in different ways, depending on what kind of bacteria causes the disease. There are three main types of vaccines. One type is made from live bacteria, and another from killed bacteria. The third type is made from inactivated poisons produced by bacteria.

Certain pathogenic bacteria become harmless after they have been grown for a while in a laboratory. When these harmless, living bacteria are injected into animals, the animals become resistant or immune to the disease caused by that strain of bacteria. During the 1980's, scientists in India developed a leprosy (Hansen's disease) vaccine that contains living but harmless bacteria. Killed bacteria of certain strains can also be used for vaccines. Most Americans are vaccinated against whooping cough with bacteria that have been killed with heat or chemicals.

Certain bacteria cause serious diseases because they produce powerful *toxins* (poisons). Vaccines to prevent some of these diseases can be prepared by growing the bacteria in a laboratory, isolating the toxins they produce, and inactivating the toxins with heat or chemicals. Most Americans are vaccinated against diphtheria and tetanus with vaccines made of inactivated toxins. Scientists also can produce vaccines by altering certain bacteria through techniques of genetic engineering (see **Genetic engineering**).

Some bacterial diseases can be controlled in ways other than vaccination. Modern methods of treating sewage, preserving food, and purifying water have greatly reduced the spread of certain bacterial diseases. For example, typhoid fever, which is usually spread in impure water, has been nearly eliminated in the United States. Another important way of controlling and curing bacterial disease is with drugs called antibiotics.

History. Bacteria were first seen in the mid-1670's by Anton van Leeuwenhoek, a Dutch amateur scientist. Although his microscopes were crude, he accurately described various bacteria. He is often called the father of bacteriology.

Work by Louis Pasteur and Robert Koch helped develop bacteriology as a science in the late 1800's. Pasteur, a French chemist, showed that bacteria cause *fermentations* (chemical changes), such as the souring of milk or the changing of wine into vinegar. He also identified bacteria that cause certain fermentations. Koch was the first bacteriologist to show that specific bacteria cause certain diseases. He found that the bacterium *Bacillus anthracis* causes anthrax in cattle and in people. In addition, Koch discovered that the rod-shaped bacterium

Mycobacterium tuberculosis causes tuberculosis.

The development of the electron microscope in the 1930's allowed bacteriologists to study the interior of bacterial cells. Today, bacteriologists are still trying to learn more about how bacteria cause disease. They are also studying ways of using bacteria to help control water pollution and to treat sewage and industrial wastes. Robert E. Marquis

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Leeuwenhoek, Anton van
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Pasteur, Louis
Wassermann, August von

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Bacteria
Disease
Gnotobiotics
Immune system
Microbiology
Microscope

Bactria. See **Afghanistan** (Early invasions).

Bad Aachen. See **Aachen.**

Baden-Baden, *BAHD uhn BAHD uhn* (pop. 48,684), is a world-famous health resort town in the northwest corner of the Black Forest in Germany. For location, see **Germany** (political map). Many hot springs in and around Baden-Baden have mineral waters that range from 117° to 154 °F. (47° to 68 °C). Thousands of visitors have drunk, or bathed in, the waters of the springs, seeking the health the waters supposedly bring. Romans used the springs about 2,000 years ago. Baden-Baden has ruins of an ancient Roman bath. It also has the largest gambling casino in Germany. Peter H. Merkl

Baden-Powell, Agnes. See **Baden-Powell, Lord; Girl Guides.**

Baden-Powell, *BAY duhn POH uhl,* **Lord** (1857-1941), founded the Boy Scout movement. His experiences as a soldier in the British Army convinced him that British boys needed more physical training and experience in outdoor life than they had been receiving. This caused him to start the Boy Scouts in Britain in 1907. With his sister, Agnes Baden-Powell, he organized the Girl Guides in Britain two years later. As scouting spread to other nations, Baden-Powell became the most important Scout leader in the world. Baden-Powell wrote a number of books on Scouting and on military campaigns.

Robert Stephenson Smyth Baden-Powell was born in London, and attended the Charterhouse school. Baden-Powell joined the British Army in 1876, and served in India, Afghanistan, and South Africa. During the Boer War in South Africa (1899-1902), his famous defense of Mafikeng, in spite of famine and sickness in his ranks, earned Baden-Powell promotion to the rank of major general. James L. Godfrey

See also **Boy Scouts.**

Badger is a digging member of the weasel family, which also includes martens, minks, otters, skunks, and wolverines. There are eight species of true badgers worldwide. The *American badger* is the only species that lives in North America. It is found from southwestern Canada to central Mexico. Another well-known species, the *Old World badger,* lives throughout Europe and northern Asia. The *ratel,* or *honey badger,* is not a true badger, though it looks and behaves like one. The ratel is found from Africa to India. See **Ratel.**

A badger has a short, broad body; black feet with long claws; and a short, bushy tail. The American badger measures 20 to 35 inches (51 to 89 centimeters) long and weighs from 8 to 25 pounds (4 to 11 kilograms). It has a grayish to reddish upper body and a dull-yellow underside. A white stripe runs from the nose to the shoulders. Badgers generally have white and black markings on the head and face.

Badgers are expert diggers, especially for their size. They dig complicated underground burrows in which they live. They also dig to catch prey and to escape danger. Badgers can dig extremely fast.

Badgers usually try to avoid their enemies by retreating or by tunneling underground. If they cannot escape an enemy, badgers become savage fighters. They use their claws and teeth as weapons and are protected by their thick fur and tough skin.

American badgers live in a variety of habitats, from grasslands to mountains. They usually are most active during the night and feed chiefly on ground squirrels and prairie dogs. They also eat burrowing rodents, rabbits, lizards, birds, and insects.

American badgers live alone. Males mate with females in the late summer. The female gives birth to one to five young the following spring. The mother takes

Warren Garst, Tom Stack & Associates

American badgers live in family groups during the spring and summer, when the adult female raises its young. In fall and winter, each badger lives alone. Badgers use their strong claws and sharp teeth to hunt and fight.

care of the young by herself. Young badgers may stay with their mother for several months.

During the winter, badgers may spend the coldest weather sleeping in their burrows. Scientists do not regard the badger's winter sleep as true hibernation. During the winter, the body temperature, breathing rate, and heart rate of badgers do not drop as much as they do in true hibernators. Also, badgers can be easily awakened and often are active on warm winter days.

Badger fur was once used to line coats and to make various brushes. However, synthetic materials have largely replaced badger fur in making these products.

Scientific classification. Badgers belong to the weasel family, Mustelidae. The scientific name for the American badger is *Taxidea taxus.* Gary A. Heidt

Badlands are regions of small, steep hills and deep gullies formed primarily by water erosion. Flash floods produce the most erosion in badland regions and commonly wear away large areas. Erosion from small watercut channels and from the splash of rainfall against hillslopes also helps shape badlands.

In many cases, the bedrock in badlands consists of thick, weakly cemented layers of rock. Soils in badland regions are usually weakly developed or are lacking altogether. As a result, most badlands are used only as grazing lands, wildlife habitats, or scenic areas.

Badlands often form naturally in arid or semiarid climates where flash floods from thunderstorms are common. Few plants grow in these regions, and the weak, bare bedrock is easily affected by rapid erosion and gullying. Badlands can also develop from poor farming or the destruction of vegetation by other means.

Major badland areas in the United States are in the Great Plains and on the Colorado Plateau. Badland areas known for their striking scenery include Badlands National Park in southwestern South Dakota and Theodore Roosevelt National Park in western North Dakota. Dinosaur Provincial Park in southern Alberta also features badlands. Richard G. Reider

See also **Alberta** (Places to visit); **Badlands National Park; Theodore Roosevelt National Park.**

Badlands National Park is located in southwestern South Dakota. Its spectacular eroded landscape contains irregular ravines, ridges, low hills, and cliffs of many colors striped with grayish-white soil. The area contains many fossils of mammals. The area was authorized as a national monument in 1929 and as a national park in 1978. For its area, see **National Park System** (table: National parks). Critically reviewed by the National Park Service

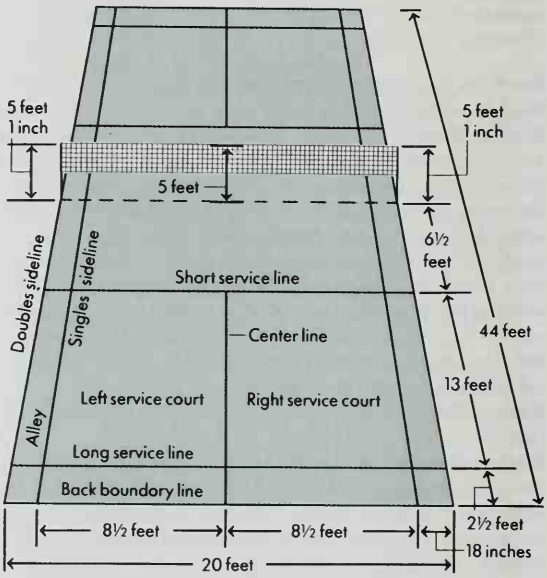
See also **South Dakota** (Visitor's guide; picture).

Badminton is a game in which opposing players use rackets to hit a *shuttle,* also called a *shuttlecock,* back and forth over a net. British officials in India learned the game, known as *poona,* and took it to England. It was played at Badminton, Gloucestershire, country home of the Duke of Beaufort, in 1873. From there, the game took its English name. Beginning in 1992, badminton became a medal sport in the Summer Olympic Games.

The Badminton Association of England established the first standard set of rules for the game in 1895. The Canadian Badminton Association was founded in 1921 and the United States Badminton Association in 1936. The International Badminton Federation (IBF) was founded in 1934. A number of countries compete every three years for the Thomas Cup for men and the Uber Cup for women.

Playing consists of *volleying* (hitting) the shuttle back and forth over the net without allowing it to hit the playing surface. The shuttle is made of feathers or nylon in a cork base. It flies slowly when hit gently. But when hit hard and timed perfectly, it may travel more than 200 miles (320 kilometers) per hour. However, the shuttle decelerates quickly after a short distance.

The badminton racket can be up to 26¾ inches (67.9 centimeters) long, and it weighs about 3½ ounces (99 grams). The badminton net is 5 feet (152 centimeters) high at the center and 5 feet 1 inch (155 centimeters) high at the posts. Two people play *singles* and four—two on each side—play *doubles.* A mixed doubles team consists of one man and one woman.



WORLD BOOK diagram by Dick Keller

A badminton court is a rectangle divided into two equal parts by a net that is suspended from posts. A number of lines further divide the court into various sections.

U.S. Badminton Association

The badminton racket has a slightly oval head, netted with light, thin strings. It is a maximum of 26¾ inches (67.9 centimeters) long. The shuttle used in tournament play is made of duck or goose feathers in a cork base. A synthetic material replaces the feathers in club or recreational play.

WORLD BOOK photo by Dan Miller

The shuttle is served with an underhand motion into the opponent's service court, diagonally opposite. The server must hit the shuttle while it is below his or her waist. The racket head must also be below the serving hand. Only one attempt on the serve is allowed. If the server fails, then the opponent serves.

The four common strokes in badminton are known as *clear,* also called *lob; drop; drive;* and *smash.* In the clear, the shuttle soars in a high arc and falls into the court behind the opponent. In the drop, the shuttle falls gently and just clears the net. The drive is a hard stroke hit on a straight line. The smash is a hard stroke hit sharply downward. All four can be forehand or backhand strokes. Much deception is possible in placing shots and in controlling the shuttle, which often will stop short in its flight and plunge down to the court.

Scoring. Only the side that is serving can score a point. The server scores (1) when the opponent lets the shuttle drop to the court and (2) by a fault. A fault occurs when the opponent touches the net or shuttle, returns the shuttle into or under the net, or hits it out of the playing area; or when the shuttle is caught and held on the racket and then slung during a stroke. A men's singles game consists of 15 points. If the score is tied at 13 all, the side first making that total has the choice of playing 5 more points or just to 15. If the score is then tied at 14 all, the side has the choice of playing 3 more points or just to 15 points. In women's singles, 11 points constitute the game. There is a choice of 3 more points if the score is tied at 9 all, and 2 more if the score is tied at 10 all. Both men's and women's doubles play to 15 points. A match is the best of three games.

Critically reviewed by the United States Badminton Association

Baeda. See Bede, Saint.

Baekeland, *BAYK land,* **Leo Hendrik** (1863-1944), a Belgian-born American chemist, improved methods of developing photographic print paper. By preparing a special form of silver chloride, he produced a superior emulsion that printed faster and allowed the substitution of artificial light for sunlight in developing prints. In 1909, he patented the first completely synthetic resin, Bakelite. He made it by combining phenol and formaldehyde. Baekeland was born on Nov. 14, 1863, in Ghent, Belgium. He graduated from the University of Ghent. He came to the United States in 1889. John A. Heitmann

Baer, *bair,* **Karl Ernst von,** *urnst fuhn* (1792-1876), a German biologist, is considered the founder of embryology. Embryology is the study of the early development of animals and plants. Baer identified the primary cell layers of embryos of mammals, and he was the first to discover the egg of the mammal in the ovary. Baer's writings include *The Origin of Mammal Eggs* (1827) and *The Embryology of Animals* (1828, 1837).

Baer was born on Feb. 29, 1792, in Estonia. He attended medical school there, and he later moved to Germany to study anatomy. In 1819, Baer became professor of anatomy at the University of Konigsberg in Konigsberg, Germany (now Kaliningrad, Russia). He accomplished his most significant work in embryology there. From 1834 to 1867, Baer worked at the Academy of Sciences in St. Petersburg, Russia. Keith R. Benson

Baez, *by EHZ,* **Joan** (1941-), is an American singer. She is known for her clear, expressive voice and her involvement in political action.

Joan Chandos Baez was born on Jan. 9, 1941, in Staten Island, New York. She achieved widespread fame after performing at the Newport, Rhode Island, Folk Festival in 1959. Baez became known for her recordings of folk ballads. In the mid-1960's, she began to perform protest songs. She also introduced the songs of Bob Dylan and other composers to a wider audience.

Baez had her greatest popular success when she recorded "The Night They Drove Old Dixie Down," in 1971. Her best-known album was *Diamonds and Rust* (1975). She wrote two autobiographies, *Daybreak* (1968) and *And a Voice to Sing With* (1987). Don McLeese

Baffin, William (1584?-1622), was an English navigator and explorer. In 1612, he went to Greenland with an expedition. In 1615, he led an expedition to find the Northwest Passage to Asia (see **Northwest Passage**). His name was given to Baffin Bay, which he explored in 1616, and to Baffin Island. He explored Greenland in 1612 and 1615. In 1616, he became the first European to reach Ellesmere Island. Sir Clements R. Markham edited stories of Baffin's expeditions and published them as *The Voyages of William Baffin* (1881). Baffin was killed while serving with the East India Company on the island of Qishm in the Persian Gulf. Barry M. Gough

Baffin Island lies north of the Canadian mainland. It is part of Canada's territory of Nunavut. The fifth largest island in the world, it covers 183,810 square miles (476,068 square kilometers). It has a rich iron ore deposit. A few Danes and Inuit (formerly called Eskimos) live along the high, rocky coast. Canada and the United States have radar stations on Baffin Island as part of their North Warning System. Auyuittuq National Park and part of Sirmilik National Park are on the island.

Baffin Island is separated from Greenland to the north by Baffin Bay. The southeastern end of the bay opens

WORLD BOOK map

Location of Baffin Island

into a wide channel called Davis Strait. The bay is about 700 miles (1,100 kilometers) long, and 70 to 400 miles (110 to 640 kilometers) wide. It is free from ice for only a short time in the summer. Black whales, walruses, and seals live in the bay. The bay and island are named for William Baffin, who explored the area in 1616.

Bostwick H. Ketchum

See also **Baffin, William.**

Baganda. See Ganda.

Baghdad, *BAG dad* (pop. 5,908,000), is the capital of Iraq and one of the largest cities of the Middle East. It is Iraq's chief center of culture, manufacturing, trade, and transportation. The city lies on both banks of the Tigris River, about 335 miles (539 kilometers) northwest of the Persian Gulf. For location, see **Iraq** (map).

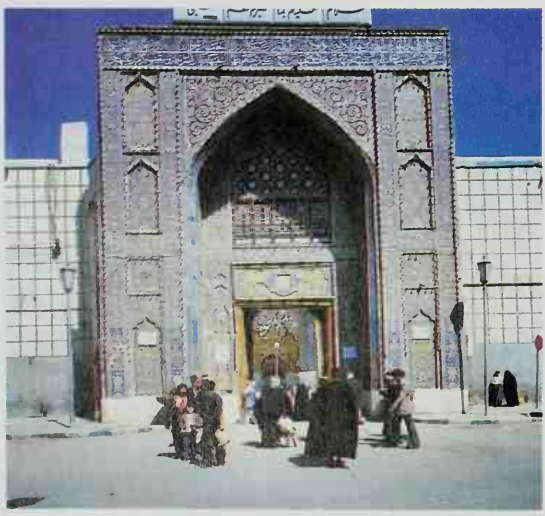
Baghdad became an important city during the A.D. 700's. Through the centuries, it has survived repeated damage by wars, fires, and floods.

The city covers about 254 square miles (657 square kilometers) on a fertile plain that is Iraq's agricultural heartland. Central Baghdad has two main districts—Karkh, on the west bank of the Tigris, and Rusafah, on the east bank. Parts of Karkh and Rusafah have narrow, dusty streets and colorful bazaars. Central Baghdad also has modern banks, department stores, and hotels. Industrial and residential districts extend in all directions from central Baghdad. The metropolitan area includes Kadhamain, a Muslim holy city.

Baghdad is the home of the University of Baghdad and al-Hikmah and al-Mustansariyah universities. The Iraq Museum in the city displays coins, sculpture, and other objects from prehistoric times to the 1600's.

People. Most of the people of Baghdad are Muslim Arabs. Jews, Christian Arabs, and Muslim Iranians and Kurds make up minority groups in the city. Arabic is the chief language, but most of the Iranians and Kurds also speak their own language.

Many of Baghdad's people share a house with at least three generations of their family. Most of the wealthy and middle-income families have brick homes that are surrounded by gardens and high walls. Thousands of the poorest people live in public housing projects on the outskirts of the city.



Shostal

Muslims in Baghdad attend highly decorated houses of worship called *mosques,* such as the one shown above. Most of Baghdad's residents are Muslims.

Economy. The Iraqi government is Baghdad's leading employer. Petroleum refining ranks as the city's chief industrial activity. Other products of Baghdad include cement, cigarettes, and textiles. Construction and trade provide many jobs in the city.

Baghdad is the center of Iraq's highway and railroad systems, which link the city with nearby nations and the Persian Gulf. An international airport serves the city.

History. People have lived in what is now the Baghdad area since about 4000 B.C. This area formed part of ancient Babylonia. From the 500's B.C. to the A.D. 600's, Persians, Greeks, and then Romans controlled the area.

An Islamic dynasty called the Abbasids gained control of the region in 750. A few years later, Abu Jafur al-Mansur, an Abbasid *caliph* (political and religious leader), chose Baghdad as the site for the new capital of the Arab Muslim empire. At that time, the empire extended from western North Africa to western China. By 800, Baghdad had nearly a million people and was a world center of education and Islamic culture.

From the 1000's to the 1200's, Baghdad gradually lost power and wealth. In 1258, Mongols from Central Asia ended the empire and destroyed Baghdad. Mongols, Persians, or Turks controlled Baghdad until 1638, when it became part of the Ottoman Empire. Wars, fires, and floods repeatedly damaged Baghdad. By the late 1700's, only about 15,000 people lived there. In the 1800's, the Ottoman Turkish government restored the city, and by 1900, the population of Baghdad was nearly 100,000.

During World War I (1914-1918), British troops captured what is now Iraq from the Ottoman Empire. The British helped establish a petroleum industry in the area. In 1932, Iraq became an independent nation with Baghdad as its capital.

The Iraqi government used much of its income from petroleum for flood control and to establish industries and schools in Baghdad. Job opportunities in the city attracted thousands of rural Iraqis, and Baghdad suffered a housing shortage. During the 1960's and 1970's, the government helped finance thousands of homes for middle-income and poor families.

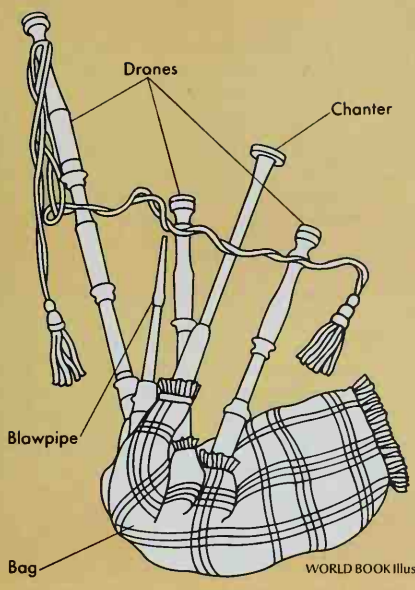
During the Persian Gulf War of 1991, Baghdad suffered heavy bombing by allied forces. The bombing destroyed much of the city's power and water supply and crippled its transportation and communication systems. Today, telephone, electricity, and water systems are almost back to what they were before the war. See **Persian Gulf War.**

Michel Le Gall

See also **Iraq** (Climate; picture).

Bagpipe is a wind instrument that consists of a leather bag fitted with one or more pipes. Bagpipes produce a continuous flow of penetrating, somewhat shrill tones. There are many varieties of bagpipes. Practically all types produce melodies within a range of nine notes. Bagpipes are used as solo instruments—often to accompany folk dances—and in military bands.

The most common type of bagpipe is the *Scottish Highland pipe,* a famous symbol of Scotland. The Highland pipe has five pipes: a *blowpipe,* a *chanter,* and three *drones.* A player blows air through the blowpipe



WORLD BOOK Illustration

© Larry Day

The bagpipe is an instrument that consists of a leather bag fitted with five wooden pipes. The player blows air through a blowpipe and presses holes in the chanter to produce music.

into the bag which is held under one arm. The player presses on the bag to force air through the other pipes, creating sound. The melody is played on the chanter, which has a double reed and eight finger holes. Each drone produces a single, steady note. Two drones sound one octave below the tonic note of the chanter, and the other drone sounds two octaves lower.

The bagpipe dates back thousands of years and is one of the oldest instruments still in use. Its origin is unknown. Different forms of the instrument evolved in various places. Melvin Berger

See also **Scotland** (picture: Bagpipes and kilts).

Baguio City, *BAG ee oh* or *BAH gyoh* (pop. 252,386), is a mountain resort city in the Philippines. It lies in an area rich in gold and copper on the island of Luzon (see **Philippines** [map]). The Philippines was a possession of the United States in the early 1900's. William Howard Taft, the American governor of the Philippines from 1901 to 1904, authorized the construction of a major road to Baguio City. Taft, who later became U.S. president, enjoyed visiting Baguio as an escape from the heat of Manila, the Philippine center of government. Taft commissioned the American architect Daniel H. Burnham, who laid out the modern city of Baguio in 1905. Baguio was nearly destroyed in 1945, during World War II, but was later rebuilt. The Japanese Army made its final stand in the Philippines near Baguio against U.S. forces led by General Douglas MacArthur. In 1990, the city was severely damaged by an earthquake, but was later rebuilt. David J. Steinberg

Bahá'ís, *buh HAH eez,* are members of the Bahá'í Faith. This religion was founded in 1863 in what is now Iraq. The Bahá'í Faith has spread throughout the world.

Bahá'ís believe that God sent a series of messengers to teach eternal moral truths and reveal new social principles. Among them are Abraham; Moses; Jesus Christ; Buddha; and Muhammad, the prophet of Islam, the religion of the Muslims. Bahá'ís believe that the latest messenger was a Persian called *Bahá'u'lláh* (Glory of God), who founded the Bahá'í Faith.

Bahá'u'lláh declared that all religions honor the same God, and that the highest form of worship is service to other human beings. He also taught that God wants all people to form a united society based on mutual acceptance. Bahá'u'lláh opposed discrimination based on age, race, or sex, and he favored a federated system of world government. He emphasized the need to pray, and to read and meditate on the word of God daily.

The Bahá'í Faith grew out of the Bábí Faith, a religion founded in Persia (now Iran) in 1844 by Siyyid 'Alí Muhammad, also called the *Báb* (Gate). The Báb predicted that a great prophet would soon appear. He won many followers, but the Persian government executed him in 1850 for his teachings. In the persecution that followed, as many as 20,000 Bábís were killed. Bahá'u'lláh was imprisoned, and then exiled to what is now Iraq. In 1863, he declared himself to be the predicted prophet. Most other Bábís accepted him and became known as Bahá'ís.

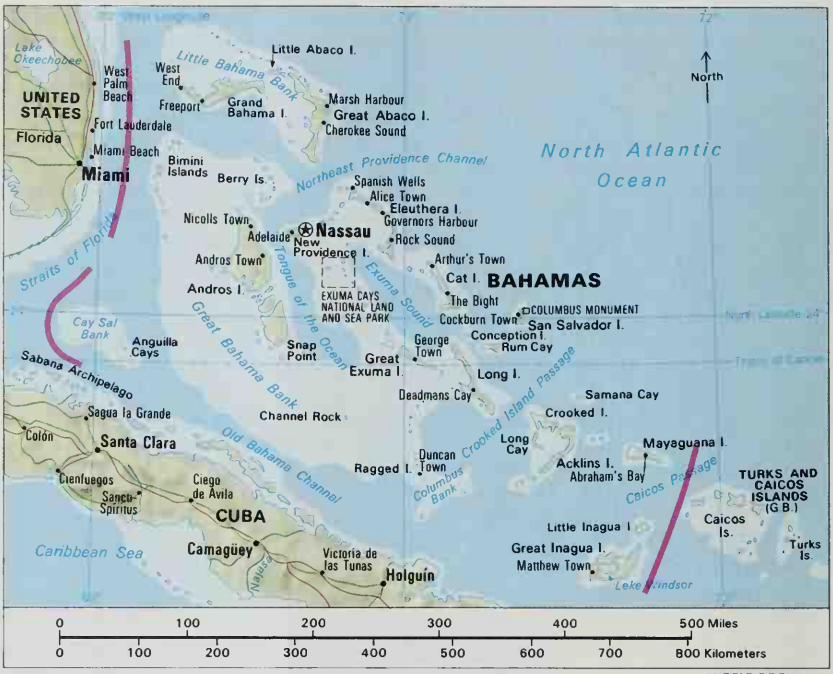
There are about 5,500,000 Bahá'ís worldwide. They have about 20,000 local councils, called Local Spiritual Assemblies, including about 1,500 in the United States. National governing bodies exist in more than 170 countries. The U.S. National Spiritual Assembly has its headquarters in Wilmette, Illinois. The Universal House of Justice, the international governing body, meets in Haifa, Israel. Critically reviewed by the Bahá'ís

Bahá'u'lláh, *bah HAH ul LAH* (1817-1892), was the founder of the Bahá'í Faith. Members of this religion re-

Cameramann International, Ltd.

This Bahá'í house of worship is in Wilmette, Illinois.

Bahamas



WORLD BOOK maps

gard him as a prophet chosen by God to convey His will.

Bahá'u'lláh, whose real name was Mírzá Husayn-Ali, was born in Tehran, Persia (now Iran). He took the name *Bahá'u'lláh,* which means Glory of God, in 1847 after he became associated with a religious movement led by a man called the *Báb* (Gate). The Bahá'í scriptures are formed by the writings of the Báb and Ábdul-Bahá, the son of Bahá'u'lláh. The Báb predicted that a great prophet would soon appear. In 1850, the Persian government executed the Báb for his teachings, and Bahá'u'lláh became a leader of the movement. The government imprisoned Bahá'u'lláh briefly in 1853 and then exiled him to Baghdad, in what is now Iraq.

In 1863, Bahá'u'lláh proclaimed himself the prophet foretold by the Báb and founded the Bahá'í Faith. Ottoman authorities, who ruled Baghdad at that time, banished him to Istanbul, in what is now Turkey, the next year. From 1868 until his death, Bahá'u'lláh lived in a prison colony in what is now Akko, Israel.

Critically reviewed by the Bahá'ís

See also Bahá'ís.

Bahamas, *buh HAH muhz,* are a chain of about 3,000 coral islands and reefs that make up an independent nation in the West Indies. They extend from about 50 miles (80 kilometers) off the eastern coast of Florida to the northeastern tip of Cuba, a distance of over 500 miles (800 kilometers). Only about 20 of the islands are inhabited. About four-fifths of the Bahamian people live on two of the islands—New Providence and Grand Bahama. Nassau, the capital and largest city, lies on New Providence. The beauty and mild climate of the Bahamas have helped make tourism the basis of the economy.

On his voyage to America in 1492, Christopher Columbus landed first at what is now San Salvador Island in the Bahamas. The Bahamas were a British colony from 1717 until 1973, when they gained independence.

Government. The Commonwealth of the Bahamas is a constitutional monarchy. The British monarch, Queen Elizabeth II, is the official head of state. A governor general represents her in the Bahamas. The two-house legislature consists of the 40-member House of Assembly and the 16-member Senate. Voters elect members of the Assembly to five-year terms. The head of the party that holds the most seats in the Assembly serves as prime minister. Senators are appointed by the prime minister, the opposition parties, and the governor general.

People. Blacks make up about four-fifths of the population of the Bahamas. Many of them are descendants of slaves brought to the islands by British Loyalists who left the United States after the Revolutionary War in America ended in 1783. The rest of the Bahamian population con-

Facts in brief

Capital: Nassau.
Official language: English.
Official name: Commonwealth of the Bahamas.
Area: 5,358 mi² (13,878 km²). *Greatest distances*—north-south, 450 mi (724 km); east-west, 435 mi (700 km). *Coastline*—1,580 mi (2,543 km).
Elevation: *Highest*—206 ft (63 m), on Cat Island. *Lowest*—sea level.
Population: *Estimated 2002 population*—317,000; density, 59 per mi² (23 per km²); distribution, 84 percent urban, 16 percent rural. *1990 census*—255,095.
Chief products: *Agriculture*—bananas, citrus fruits, cucumbers, pineapples, tomatoes. *Manufacturing*—cement, food products, petroleum products, rum.
National anthem: "March On, Bahamaland."
Flag: A black triangle represents the Bahamian people. Blue and gold horizontal stripes stand for the sea and the land. The flag was adopted in 1973. See Flag (picture: Flags of the Americas).
Money: *Basic unit*—Bahamian dollar. One hundred cents equal one dollar.

sists chiefly of whites and *mulattoes* (persons of mixed black and white ancestry).

Almost all Bahamian adults can read and write. The law requires children from 5 to 14 to go to school. Religious groups in the Bahamas include Anglicans, Baptists, Methodists, and Roman Catholics.

Land and climate. The Bahamas consist of nearly 700 islands and about 2,300 rocky islets and reefs. The principal islands include Acklins, Andros, Cat, Eleuthera, Grand Bahama, Great Abaco, Great Exuma, Great Inagua, Little Abaco, New Providence, and San Salvador. Most of the Bahamas are long, narrow strips of limestone, covered by a thin layer of stony, infertile soil. Pine forests cover parts of many of the islands.

The Bahamas have a mild climate. Temperatures average about 72 °F (22 °C) during the winter and about 85 °F (29 °C) in summer. An average of about 45 inches (114 centimeters) of rain falls annually.

Economy. Tourism ranks as the leading economic activity of the Bahamas. Many Bahamians work in hotels or in other businesses related to tourism.

Less than 2 percent of all Bahamian workers farm the land, and the country must import most of its food. Farmers grow bananas, citrus fruits, cucumbers, pineapples, tomatoes, and other crops. Crawfish and other seafood are caught for local use and for export.

A number of foreign corporations operate businesses in the Bahamas. The country has branches of many foreign banks. Manufacturing plants include a cement factory, a petroleum refinery, and a rum distillery. Food processing also ranks as a major industry.

Cargo and passenger ships sail among the Bahamian islands and to and from other countries. Nassau is the country's chief port. An international airport is in Nassau.

History. Lucayo Indians lived in what are now the Bahamas long before Europeans first arrived. In 1492, Christopher Columbus landed at San Salvador Island and claimed it for Spain. The Spanish did not settle in the Bahamas. But they enslaved the Lucayo and took many of them to work in gold mines on the nearby islands of Cuba and Hispaniola. The Bahamas remained almost totally uninhabited until the mid-1600's, when the British began to settle there.

© Dave G. Houser

Nassau, the capital of the Bahamas, was founded by the British in the 1600's. The British built Fort Fincastle, *foreground,* in 1793.

At first, Spain did not challenge the British settlement of the Bahamas. But beginning in the late 1600's, Spanish forces attacked the British settlements several times. Pirates who used the Bahamas as a base for their expeditions also raided the British communities.

The Bahamas became a British colony in 1717. In time, the colonial government succeeded in defending the Bahamas against the pirate attacks. Spain gave up its claim to the islands in 1783, under the Treaty of Paris. After the Revolutionary War in America (1775-1783), many British Loyalists from the United States settled in the Bahamas. They brought their slaves and set up plantations. The United Kingdom abolished slavery in 1833.

During the American Civil War (1861-1865), the Bahamas served as a base for ships breaking the Union blockade of Confederate ports. These blockade runners carried on a profitable trade between the Confederacy and Europe. After the war, the Bahamas went through an economic decline. This period lasted until the mid-1900's, when many tourists began to visit the islands.

The United Kingdom granted the Bahamas internal self-government in 1964. After the 1967 legislative elections, the Progressive Liberal Party (PLP), composed largely of blacks, won control of the government. The PLP brought black majority rule to the islands for the first time. The party, led by Prime Minister Lynden O. Pindling, worked to gain independence. The Bahamas became independent on July 10, 1973. Since the early 1980's, large numbers of people from Haiti have fled to the Bahamas to escape poverty and political unrest.

Pindling served as prime minister of the Bahamas until 1992. In that year, the Free National Movement (FNM) defeated the PLP in legislative elections. FNM leader Hubert Ingraham replaced Pindling as prime minister. The FNM won elections again in 1997, and Ingraham remained prime minister. In elections held in 2002, the PLP regained control of the government, and PLP leader Perry Christie became prime minister. Thomas D. Boswell

See also Nassau; West Indies.

Bahia. See Salvador.

Bahrain, *bah RAYN,* is an island country in the Persian Gulf in southwest Asia. Barren desert covers most of the more than 30 islands that make up this Arab land. The main island is also called Bahrain.

Bahrain has been a center of trade and communications in the Persian Gulf area for many centuries. But the country was underdeveloped until the discovery of petroleum on the island of Bahrain in 1932. Today, the nation has one of the highest standards of living in the gulf area. Bahrain was a British protectorate from 1861 to 1971, when it gained independence. Manama is the capital, largest city, and chief commercial center of Bahrain.

Government. In 2001, Bahraini voters approved a national charter to reform their country's government. The reforms, which took effect in 2002, changed Bahrain from an *emirate,* ruled by an *emir* with absolute power, to a constitutional monarchy, with a king and a two-house legislature. One house was scheduled to be elected in October 2002. The other was to be appointed by the king. Local officials were elected in May 2002. Both men and women are allowed to vote and run for office.

People. Most of Bahrain's people live in cities and villages in the northern part of the island of Bahrain. Arabs make up about 80 percent of the population. Bahrain also has large groups of Indians, Iranians, and Pakistanis. Almost all the people are Muslims, and Islam is the national religion. A majority of the Muslims belong to the Shiah branch of Islam. Most of the rest, including members of the ruling family, belong to the Sunni branch.

Most Bahrainis live in houses or apartments, but some villagers have thatched huts. The nation has one of the best electric supply systems in the Middle East. As a result, air conditioners and refrigerators are common in Bahrain. Clothing styles, especially among the young, reflect Western influence. But many still wear Arab dress. Chief foods include dates, fish, fruit, milk, and rice.

Arabic is the official language of Bahrain. Many people also speak English and Farsi. Newspapers and magazines are published in both Arabic and English.

Bahrain has one of the highest literacy rates in the Persian Gulf area. Education is free, and children are required by law to attend primary school. The University College of Arts, Science and Education, and the University of the Arab Gulf provide higher education. The government of Bahrain provides free medical care.

Land and climate. Most of Bahrain consists of desert. The island of Bahrain makes up almost the entire country. Other islands include Al Muharraq, Sitrah, and Umm Nasan. Bridges connect the principal islands. A causeway links Bahrain to the Saudi Arabian mainland.

WORLD BOOK maps

Many freshwater springs provide ample drinking water for the northern coast of the island of Bahrain. Farmers use much of this spring water to irrigate their land. Northern Bahrain receives most of the little rain that falls. The rainfall averages about 3 inches (8 centimeters) a year, most of it during the winter months.

Bahrain has hot, humid summers. The temperature often rises above 100 °F (38 °C) from June to September. Winter temperatures are mild, ranging from about 50 °F (10 °C) to about 80 °F (27 °C).

Economy. Bahrain's economy depends largely on the petroleum industry. Bahrain has only a small petroleum supply. But its oil refinery, on the island of Sitrah, ranks as one of the largest and most modern in the world. This refinery processes all the country's crude petroleum, as well as much oil that comes from Saudi Arabia by pipeline. Bahrain also has valuable natural gas reserves.

Bahrain ranks as a major banking center for the Persian Gulf region and as the financial center of the Middle East. Many large companies have their Middle East headquarters in Bahrain. Ship repairing is an important industry. Manufactured goods include aluminum and aluminum products, ammonia, iron, liquid natural gas, methanol, and refined petroleum products. Many Bahrainis hold government jobs. Farmers grow dates, tomatoes, and other fruits and vegetables on irrigated land in northern Bahrain. Some raise cattle and poultry. Fish and shrimp are caught in the coastal waters.

Modern warehouse and port facilities help make Bahrain a major trading center of the Persian Gulf area. Petroleum products are the chief exports. The country imports clothing, crude petroleum for refining, food, industrial machinery, and motor vehicles. Bahrain reexports some of these goods to neighboring countries.

An airport on Al Muharraq links Bahrain to other nations. The government operates a radio station and a television station in Bahrain.

History. Dilmun, a prosperous trading civilization from about 2000 B.C. to 1800 B.C., once occupied the area that is now Bahrain. Portugal controlled Bahrain during the 1500's, and then Persia (now Iran) ruled the country. In 1782, the Al-Khalifa clan, a group of Arabs

Facts in brief

Capital: Manama.
Official language: Arabic.
Official name: Kingdom of Bahrain.
Form of government: Constitutional monarchy. *Head of state*—King.
Area: 268 mi² (694 km²). *Greatest distances*—north-south, 50 mi (80 km); east-west, 26 mi (42 km). *Coastline*—78 mi (126 km).
Elevation: *Highest*—Jabal ad Dukhan, 443 ft (135 m) above sea level. *Lowest*—sea level.
Population: *Estimated 2002 population*—636,000; density, 2,373 per mi² (916 per km²); distribution, 88 percent urban, 12 percent rural. *1991 census*—508,037.
Chief products: *Agriculture*—dates, tomatoes. *Fishing*—shrimp, crab, rabbitfish, perch, sea bream, grouper. *Manufacturing*—aluminum and aluminum products, ammonia, iron, liquid natural gas, methanol, refined petroleum products. *Mining*—natural gas, petroleum.
Flag: A red field covers about three-fourths of the flag and adjoins the jagged edge of a vertical white stripe. See Flag (picture: Flags of Asia and the Pacific).
Money: *Basic unit*—dinar. One thousand fils equal one dinar.

from what is now Saudi Arabia, drove the Persians from Bahrain. The clan has ruled the country ever since.

In the early 1800's, the United Kingdom helped the Bahrainis fight Saudi Arabian invaders. Bahrain became a British protectorate in 1861. In return for protection, Bahrain gave control of its foreign affairs to the British.

In the 1920's and 1930's, Bahrain set up modern social welfare programs, built hospitals and schools, and provided better working conditions for laborers. In 1932, petroleum was discovered on the island of Bahrain.

During the late 1940's and the 1950's, many Bahrainis demanded more participation in their government. The government granted minor political reforms after widespread rioting broke out in 1956. In 1970, the emir, Sheik Isa bin Salman Al-Khalifa, turned over some of his power to a Council of State, now the Cabinet.

The British withdrew from the Persian Gulf in 1971. That year, Bahrain gained independence and joined the Arab League and the United Nations. In 1973, Bahrain adopted a constitution that created a national assembly elected by the people. Sheik Isa disbanded the assembly in 1975. In the 1970's and early 1980's, Bahrain's rapid economic development attracted many immigrants. In 1981, Bahrain and other states of eastern Arabia formed the Gulf Cooperation Council (GCC) to work together in such matters as defense and economic projects.

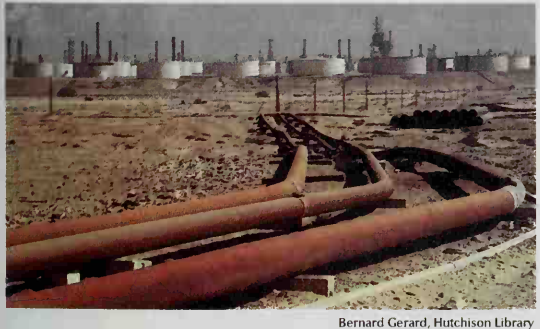
In August 1990, Iraq invaded Kuwait. In 1991, Bahrain allowed the United States and the United Kingdom to use its territory for air force and naval bases to attack the Iraqi forces. As part of the GCC, Bahrain took part in the bombing of Iraqi military targets and in the ground offensive that liberated Kuwait. See **Persian Gulf War**.

In the mid-1990's, several Shiite-led anti-government protests broke out in Bahrain. Protesters called for the national assembly to be restored and for free elections. In 2001, Bahrain held a referendum on a National Action Charter, which called for Bahrain to become a constitutional monarchy with an elected legislature. Voters overwhelmingly approved the charter. In February 2002, the emir, Sheik Hamad bin Isa Al-Khalifa, declared Bahrain to be a constitutional monarchy and himself to be king. Municipal elections were held in May 2002. Legislative elections were set for October 2002. Michel Le Gall

See also **Arab League; Gulf Cooperation Council; Manama.**

Bahutu. See **Hutu.**

Baikal, Lake. See **Lake Baikal.**



Bernard Gerard, Hutchison Library

Bahrain's oil refinery rises from the desert on the island of Sitrah. This refinery is one of the largest in the world. The economy of Bahrain depends largely on the oil industry.

Bail is security deposited with a court to obtain the release of an arrested person by ensuring that the person will reappear to stand trial. Bail may also be set for a person appealing a sentence. In most cases, the judge sets bail—also known as a *bail bond*—at a certain sum of money. If the accused appears in court, the money is refunded. If not, it is forfeited. An accused person or a friend or relative may put up the bail; or a *bondsman* or *bondswoman* may provide bail for a fee. If no one puts up the bail, the person must stay in jail until the trial.

If the judge believes an accused person will appear as required, the judge may accept the person's promise to return instead of money. This practice is known as releasing someone *on his or her own recognizance.*

According to the Eighth Amendment to the United States Constitution, the courts cannot require excessive bail. This provision is designed to prevent courts from setting bail so high that no one could furnish it. But people do not always have a right to bail. People who are likely to *jump bail* (fail to appear), such as those accused of murder or espionage, may be denied bail. Repeat offenders or those thought too dangerous to be released may be held in *preventive detention.* Jack M. Kress

Bailey, Liberty Hyde (1858-1954), an American botanist and horticulturist, was responsible more than any other person for the development of agricultural education in the United States. As dean of the College of Agriculture at Cornell University from 1903 to 1913, he built the college into a major institution. Bailey worked to make botanical knowledge available to farmers and gardeners, and to make botanists understand the practical problems of agriculture and horticulture. He also pioneered in plant-breeding experiments. In 1908, President Theodore Roosevelt appointed Bailey chairman of the Country Life Commission, a group that helped bring about a rural parcel post and a system of federal agricultural credit. Bailey's *Cyclopedia of American Horticulture* (1900-1902) became a standard reference book.

Bailey was born in South Haven, Michigan, on March 15, 1858. He graduated from Michigan Agricultural College (now Michigan State University). Douglas E. Bowers

Baily's beads are the brilliant points of light seen just as the sun's surface disappears behind the moon during an eclipse (see **Eclipse**). The beads appear when the irregular edge of the moon breaks up the last thin crescent of the sun into many sections. The last bead seen shines like a diamond on the ring of the sun's outer atmosphere—a spectacle known as the *diamond-ring effect.* Baily's beads also can be seen as the sun's surface reappears from behind the moon. The beads were named for British astronomer Francis Baily, who first described them as beads in 1836. Jay M. Pasachoff

Baird, John Logie (1888-1946), a Scottish engineer, gave the first public demonstration of a television technology that used mechanical devices in the camera and receiver. The event took place in April 1925 in England.

In 1928, Baird broadcast pictures from London to New York. In 1929, the British Broadcasting Corporation (BBC) began regular experimental broadcasts using Baird's technology. In 1937, however, the BBC selected a competing all-electronic system for its broadcasts. Baird had joined Philo T. Farnsworth, an American pioneer in all-electronic TV, to combine the two technologies. However, fire destroyed Baird's laboratory before a

merged system could be publicly tested. Baird was born in Helensburgh, Scotland. Joseph H. Udelson

Baker, George. See Divine, Father.

Baker, Howard Henry, Jr. (1925-), a Republican from Tennessee, served as majority leader of the United States Senate from 1981 to 1985. He was a member of the Senate from 1967 to 1985. In 1987 and 1988, he served as President Ronald Reagan's chief of staff. Baker was an unsuccessful candidate for the Republican presidential nomination in 1980. In 2001, President George W. Bush appointed Baker U.S. ambassador to Japan.

Baker gained national recognition in 1973 during the hearings of the committee that investigated the Watergate scandal (see Watergate). He was the committee's vice chairman. Baker served as Senate minority leader from 1977 to 1981. When the Republicans took control of the Senate in 1981, he became Senate majority leader. In that position, Baker played a key role in winning passage of legislation proposed by President Reagan.

Baker was born in Huntsville, Tennessee. He graduated from the University of Tennessee Law School in 1949. His election to the Senate in 1966 made him the first Republican elected from Tennessee since the 1860's. Baker was married to Joy Dirksen, daughter of U.S. Senator Everett Dirksen, from 1951 until her death in 1993. In 1996, he married Nancy Kassebaum, a U.S. senator from 1979 to 1997. Guy Halverson

Baker, James Addison, III (1930-), served as United States secretary of state under President George H. W. Bush from 1989 to 1992. As secretary, Baker helped form the coalition of countries that fought Iraq in the Persian Gulf War (1991). After the war, he helped coordinate relief efforts for Kurdish refugees in Iraq. The Kurds had fled their homes in Iraq after the Iraqi military put down a rebellion there. Baker promoted peace between Arab nations and Israel.

© Dirck Halstead, Gamma/Liaison

James Baker

Baker served as secretary of the treasury under President Ronald Reagan from 1985 to 1988. In this post, Baker led the Reagan Administration's revision of the federal tax system.

Baker was born in Houston. He graduated from Princeton University in 1952 and from the University of Texas Law School in 1957. Baker practiced law in Houston from 1957 until 1975, when President Gerald R. Ford named him undersecretary of commerce. From 1981 to 1985, Baker served as Reagan's chief of staff. Baker managed George H. W. Bush's presidential campaigns in 1980, 1988, and 1992 and served as Bush's chief of staff in 1992 and 1993. In 2000, Baker represented the presidential campaign of Bush's son George W. Bush as an observer to the vote recount in Florida. Bush won the presidency in one of the closest races in United States history.

William J. Eaton

Baker, Josephine (1906-1975), was an internationally famous African American entertainer. She began her career in the early 1920's as a chorus dancer in black musical comedies and in black nightclubs in New York City. She did not become a star until she moved to Paris in 1925, where she performed in black revues at the Folies Bergère and other Parisian music halls. She also owned a nightclub. Her rhythmic dancing and flamboyant stage presence made her a sensation by the late 1920's.

Bettmann Archive

Josephine Baker

Baker returned to the United States to perform in the *Ziegfeld Follies of 1936.* She also operated a nightclub in New York City. She retired in 1956 to devote more time to her family of adopted children. She raised her family on her estate in France until financial difficulties forced the sale of the property. Baker was born in St. Louis. Gerald Bordman

Baker, Sir Samuel White (1821-1893), was an English explorer of Africa. He became known as an expert on Egypt and Sudan chiefly through two of his books, *The Albert N'yanza, Great Basin of the Nile* (1866) and *The Nile Tributaries of Abyssinia* (1867).

Baker was born in London. During the late 1850's and early 1860's, he and Florence von Sass, whom he later married, explored the region of the White Nile, the Blue Nile, and the Atbara River in Africa. On March 14, 1864, Baker and his party found a great lake. The lake, which he named Albert Nyanza (now also called Lake Albert), lies between Uganda and Congo (Kinshasa) and is one source of the Nile River. Baker was knighted in 1866. In 1869, Ismail Pasha, the ruler of Egypt, appointed him as governor general of Sudan, then controlled by Egypt. Ismail told Baker to eliminate the slave trade. Baker added new territory in Sudan for Egypt and defeated some slave traders but failed to stop the slave trade. He returned to the United Kingdom in 1873. Cora Ann Presley

Baker v. Carr was a landmark decision of the Supreme Court of the United States concerning *apportionment* (distribution of seats) in state legislatures. In the 1962 decision, the Supreme Court ruled that federal courts have authority to decide lawsuits challenging the fairness of state apportionment. This decision helped shift the political power from rural to urban areas.

The case began in 1959 when Charles Baker and several other residents of Tennessee urban areas sued Tennessee Secretary of State Joseph Carr. They argued that the state discriminated against urban residents by failing to provide equal representation in the legislature. A United States district court refused to hear the case. However, the Supreme Court ordered it to do so in its 1962 decision. Stanley I. Kutler

Baking. See Bread; Cooking (Methods); Pastry.

Baking powder is a fine white powder used to make cakes and biscuits *leaven* (rise). Cooks add baking powder to flour mixtures before baking them. Chemicals in baking powder react with air and a liquid (usually water or milk) to form carbon dioxide. Bubbles of carbon dioxide are trapped in the flour mixture. The bubbles expand when they are heated and make the mixture rise.

All baking powders contain starch, baking soda (sodium bicarbonate), and acid-forming ingredients. The

starch keeps the powder dry and prevents it from acting until a liquid is added. Baking soda reacts with the acid-forming ingredient to produce carbon dioxide. Different kinds of baking powders contain different acid-forming ingredients. *Tartrate* baking powders contain cream of tartar and tartaric acid as acid-forming ingredients. *Phosphate* powders have calcium dihydrogen phosphate. *Sulfate* powders contain sodium aluminum sulfate, or *alum. Combination,* or *double-acting,* powders have phosphate and sulfate.

Baking powders differ in speed of reaction. Sulfate powder is the slowest baking powder. It does not react fully until heated. Tartrate and phosphate powders are the fastest. They react as soon as they are mixed with a liquid. Combination powders are the most widely used type. They react equally well in both the mixing and baking processes. Baking soda and sour milk have the same rising effect on flour mixtures as baking powder and sweet milk. Kay Franzen Jamieson

See also **Alum; Phosphate; Soda.**

Bakke case, *BAH kee,* was an important civil rights case decided by the Supreme Court of the United States. In this 1978 decision, the court ruled that university admissions policies may not use quotas to achieve racial balance. However, these policies may give special consideration to members of minority groups to achieve variety in a student body.

The official name of the Bakke case is *Regents of the University of California v. Allan Bakke.* Bakke, a white engineer, was refused admission to the University of California Medical School at Davis in both 1973 and 1974. He later learned that his grades and test scores were higher than those of several applicants who had been admitted to the school under a special program for members of minority groups. Bakke sued the university, claiming that his application had been rejected only because he was white.

The Supreme Court issued a two-part decision. In the first part, five justices ruled against the medical school's special admissions program and ordered Bakke admitted. Four justices based their decision on the Civil Rights Act of 1964, which prohibits racial discrimination by a school receiving federal funds. The fifth justice, Lewis F. Powell, Jr., based his decision on the 14th Amendment to the Constitution, which guarantees all citizens equal protection of the law.

Powell issued an additional opinion, which formed the second part of the Supreme Court's decision. He stated that schools could consider race or ethnic background as one factor among others in determining admissions. Powell's opinion was supported by the four remaining justices, who upheld the medical school's plan. The decision was widely regarded as a compromise that did not help schools determine how to achieve a desired racial mix of students without impermissible racial quotas. Jethro K. Lieberman

Baku, *bah KOO* (pop. 1,084,000; met. area pop. 1,661,000), is the capital and largest city of Azerbaijan. Baku, which is also spelled *Baky,* is located on the east coast of the country along the Caspian Sea (see **Azerbaijan** [map]). It is Azerbaijan's chief port and the country's political, economic, and cultural center. The Baku area serves as an important oil-producing region. Its products also include cotton, natural gas, processed meat, ships, and textiles.

Baku has existed since at least the 800's. Early in its history, it fell under Persian and Turkish control. Russia took over Azerbaijan in the early 1800's. Russia developed the country's industry, particularly petroleum production. By the late 1800's, Baku had become the world's leading producer of refined petroleum. From 1922 to 1991, Azerbaijan was part of the Soviet Union. It became independent in 1991. Baku remains an important oil center, processing oil from offshore wells in the Caspian Sea. Jaroslaw Bilocerkowycz

See also **Azerbaijan** (picture).

Balaklava, *BAL uh KLAH vuh,* **Battle of,** was fought near the town of Balaklava in the Crimea, on Oct. 25, 1854, during the Crimean War. British, French, and Turkish troops had easily captured Balaklava and set up a base there. The Russians sent a large force from Sevastopol, a naval base near Balaklava, to reconquer the town. The attack failed, but both sides suffered heavy losses. See **Crimean War.**

During the battle, a small brigade of British cavalry made a gallant but tragically useless attack on a strong Russian position. Nearly 250 of the 673 men in the "Light Brigade" were killed or wounded. The stupidity and personal rivalry of two British officers were probably the chief causes of the tragedy. The attack was not important. But it has been remembered because the British poet Lord Tennyson made it famous in his poem, "The Charge of the Light Brigade." This poem glorifies the idea that a soldier must blindly obey his orders.

Philip Dwight Jones

See also **Nightingale, Florence.**

Balalaika, *BAL uh LY kuh,* is a stringed musical instrument with a triangular body and a long neck with *frets*

© Pamella McReynolds

The balalaika is plucked with the fingers or a pick called a *plectrum.* It produces a sound similar to that of a mandolin.

(ridges). Most balalaikas have three strings. Others have two or four strings. The player plucks the strings with the fingers of the right hand and sets the pitch with the fingers of the left hand. Balalaikas are made in six sizes. The largest ones must be rested on the floor when they are played. The balalaika was developed by the Tatars of central Russia and became generally popular in the early 1700's. The instrument is used most commonly in performing Russian songs and dance music. Abram Loft

Balance is a device that weighs substances. The simplest analytical balance consists of a horizontal bar balanced on a thin edge of metal or some other hard substance. A pan is suspended on each end of the bar. A

Ohaus Corporation

A trip balance has two pans. One pan holds the object to be weighed *(left),* and the other holds standard weight units.

pointer, attached to the bar, swings across a scale as the bar moves up and down. Weights are placed in one pan, and the substance to be weighed in the other. When the weight in both pans corresponds, the arm remains horizontal, and the pointer motionless. This kind of balance can weigh small objects to the nearest 0.1 milligram ($\frac{4}{1,000,000}$ ounce).

In a trip balance, the pans push downward on the horizontal bar instead of hanging from it. An upright pointer indicates slight imbalances between the weights in one pan and the object to be weighed in the other pan. A tiny weight on the horizontal bar can be moved to restore the balance and give the object's weight to the nearest 0.1 gram ($\frac{4}{1,000}$ ounce).

Today, many balances use only one pan. An object is placed on the pan, and built-in weights respond to the force with which the object pushes down. On many balances, an electronic digital display indicates the object's weight. Lucille B. Garmon

See also Scale, Weighing.

Balance of nature. Plants, animals, and other organisms that live together in the same area—such as a forest or a pond—form a *community.* Within a community, the members of one species make up a *population.* The size of each population stays fairly stable unless some change alters conditions in the community. Biologists refer to the relative stability of each population within a community as the *balance of nature.*

Maintaining the balance

All living things are closely related to their environment. Any change in one part of nature—for example, a natural increase or decrease in a population of any species of animal or plant—causes reactions in several other parts. In most cases, these reactions work to restore the balance of nature.

Ecosystems. An ecosystem consists of the *biological* and *physical* environments of an area. The biological environment is made up of all living things in the community. The physical environment includes air, soil, water, and weather. All these biological and physical factors interact within an ecosystem. They compose a network of complex relationships that control population growth.

Each organism is related to a variety of the biological and physical factors of its ecosystem. For example, rabbits need air and water from the physical environment to breathe and drink. They also need biological features, such as plants, for food and *cover* (shelter). On the other hand, rabbits are eaten by foxes and other *predators* (flesh-eating animals). In addition, several kinds of parasites live in and on rabbits.

The relationship among rabbits, plants, and foxes can be shown by an example of an ecosystem that includes these three organisms. Assume that during a certain year, the temperature and rainfall within this ecosystem are ideal for plant growth. As a result, rabbits have a more plentiful supply of food than usual. The female rabbits are well-fed and healthy, and most of them produce large litters. The young rabbits have enough food, and nearly all of them survive. In time, the area becomes overpopulated with rabbits, and they continually compete with one another for food and cover. The losers become weak and unprotected, and they may fall victim to disease and parasites. They also become easy targets for foxes, and so the rabbit population decreases.

More rabbits means more food for foxes. The foxes respond in much the same way as the rabbits did to an increased food supply—their population grows. But more foxes means that even more rabbits are hunted, and so the number of rabbits shrinks even further. The rabbit population will continue to decrease until it again comes into balance with the ecosystem's ability to support it—an ability known as the ecosystem's *carrying capacity.* Similar controls govern plant populations. On a small scale, such actions and reactions go on every day.

Competition plays a major role in controlling population growth. An ecosystem has limited amounts of the food and cover necessary for each population. Therefore, individual members of the same population must compete for those necessities. But competition is much less intense between different populations. For example, deer and rabbits are *herbivores* (plant-eating animals), but they usually eat different kinds of plants.

Competition for food. If a population becomes too large for the available supply of food, many of the weaker members will starve. Others may migrate into another ecosystem, but they may not survive. Still others, weakened by hunger, may die from disease and parasites, or they may be killed by predators.

Competition for cover. Cover is a requirement for most populations. Only a certain number of rabbits can live in a given brier patch, and only so many foxes can occupy the available den sites. If the rabbit population becomes too large for the brier patch, competition will force some individuals to live in poorer cover. There,

they will be more likely to be attacked by predators or by disease and parasites.

Predators can help maintain the quality of their prey population if the two species have lived for a long time in the same ecosystem. Under such conditions, the prey species learns to deal with the predators. Therefore, predators normally kill only the weakest and least desirable members of the prey population. The prey population thus stays in a healthy state.

Disease and parasites can reduce or even wipe out a population. But most *pathogens* (diseases and parasites) have been present throughout history. Most *host* (infected) species have become adapted to living with their pathogens. Disease and parasites serve as important population controls primarily in the presence of other factors, such as competition for food or cover.

Behavior helps govern the size of some animal populations. Three behavioral factors may be important: (1) *territoriality,* (2) *dominance hierarchy,* and (3) *stress.*

Territoriality occurs among animals that require a certain minimum amount of space, regardless of the available food and cover. Among such species, one animal or a group of animals establishes a territory. No other members of the species are allowed in this area, and breeding is usually restricted to the animals with territories. Such behavior ensures that the strongest members of the population—the animals with territories—survive and produce offspring. See **Territoriality.**

Dominance hierarchies, often called "pecking orders," occur among many types of social animals. Within populations of such animals, the stronger individuals dominate the weaker ones. These dominant animals get the best food, cover, and breeding places. Weaker individuals are forced into areas with poorer food and cover, and some do not survive. The offspring of dominant parents also have the best chance to survive. The traits of the strongest individuals thus are passed on to the next generation of the species. See **Dominance.**

Stress occurs among crowded populations of animals. Stressed animals become aggressive and irritable, and they often fight with one another. Some individuals do not breed, and those that do breed produce small litters. Many females do not take care of their young. Diseases and parasites spread rapidly among crowded animals, further reducing their number.

Upsetting the balance

Natural factors and human factors may alter the relationships within an ecosystem. Earthquakes, floods, and fires started by lightning are natural factors that may upset nature's balance. Human factors that may do so include logging and livestock grazing. As a result of these and other factors, entire populations may be wiped out or may grow suddenly at an astounding rate.

A historical example illustrates a change in balance. During the early 1900's, a stable population of about 4,000 mule deer lived on the Kaibab Plateau in northwestern Arizona. Beginning in 1907, human hunters began killing the deer's natural predators—coyotes, mountain lions, and wolves. As a result, the population of deer increased to about 100,000 by 1924. But there was not enough food for so many deer, and thousands starved. Balance did not return to this ecosystem until 1939.

In another case, a chain of events known as the *ripple effect* began when fishing crews apparently overharvested fish populations in the northern Pacific Ocean. As a result, seals and sea lions, which eat fish, declined. In 1998, biologists reported that killer whales, which normally prey on seals and sea lions, had begun to prey on sea otters. The killer whales sharply reduced some sea otter populations. Next, sea urchins, a major food of the otters, increased. The sea urchins consumed huge amounts of a type of algae known as *kelp.* They reduced the ocean's kelp beds, which provide habitat for many other species. Beginning with fewer fish, an entire marine ecosystem—seals and sea lions, killer whales, sea otters, sea urchins, and kelp beds—was upset. No one knows when balance will return. Eric G. Bolen

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The balance of nature is maintained, in part, by predators. One such predator is the common buzzard, shown here killing a rabbit. Buzzards generally prey on the weakest rabbits. Thus they help keep rabbit populations stable and healthy.

Related articles in *World Book* include:
Animal (The importance of animals)
Bird (The importance of birds)
Botany (The importance of botany)
Carson, Rachel
Ecology
Fish (Fish in the balance of nature)
Plant
Wildlife conservation

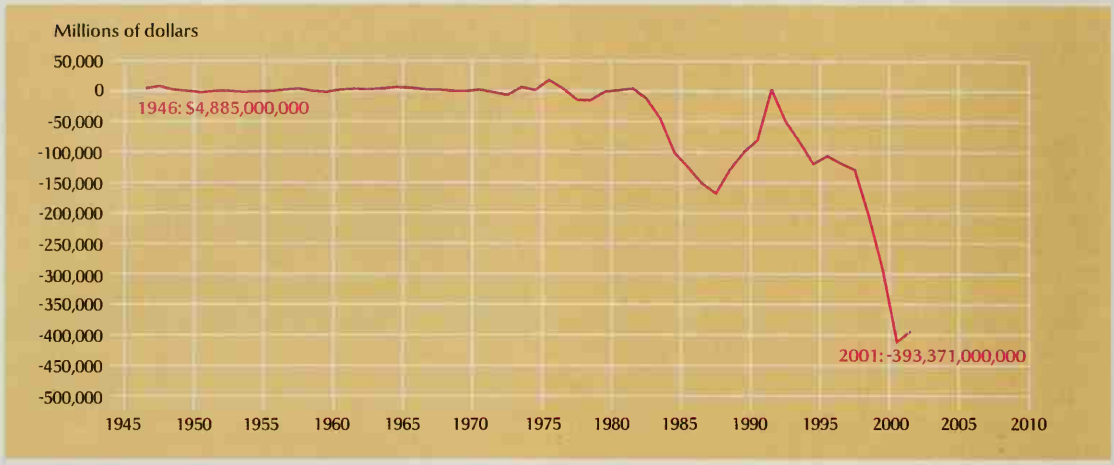
Balance of payments is a record of the value of all economic transactions that one nation has with other nations during a certain period. It lists total payments and receipts from such sources as merchandise trade, services, and borrowing and lending for investment.

How balance of payments is determined. The United States Department of Commerce and the International Monetary Fund issue balance-of-payments data on the United States and other nations. These reports divide a country's balance-of-payments account into two major categories, a *current account* and a *capital account.* The current account reflects the flow of merchandise, services, and transfer payments in and out of the country. A merchandise trade section records the value of the nation's imports and exports. Services include interest and dividends the country earns or pays to other nations, wages to foreign workers, and transportation and travel. Transfer payments include grants, gifts, and pensions.

The capital account itemizes the value of loans made by foreigners in the country and by the nation's citizens

United States balance of payments

This chart shows a category of the U.S. balance of payments, the *current account,* since 1946. The account includes exports and imports, foreign aid, income on investments, and tourist spending.



Source: U.S. Bureau of Economic Analysis.

abroad. It also records the value of investments by multinational corporations; sales and purchases of stocks, bonds, and other securities; and foreign currencies bought and sold by the nation's central bank.

Because all transactions between nations consist of two sides—the receipt of, and the payment for, an item—the two sides must always be equal. But parts of a balance-of-payments report may show a *surplus* or *deficit* and need not balance. For example, if a nation imports more than it exports, it would show a deficit in the merchandise trade section of the current account. A nation exporting more than it imports would have a surplus.

Balance of payments and exchange rates. Changes in a nation's receipts and payments may affect its *exchange rate,* the value of its currency in relation to foreign currencies. Different countries follow different exchange rate systems. In a freely floating system, exchange rates vary continuously in response to changes in international receipts and payments. Generally, if receipts exceed payments at a particular time, the country's currency will *appreciate* (increase in value) in relation to other currencies. If payments exceed receipts, the country's currency will *depreciate* (fall in value). In a fixed exchange-rate system, a country's central bank buys or sells foreign currencies in exchange for its own money to keep its exchange rate constant. Some countries follow a managed floating system, in which the central bank buys or sells foreign currencies only to moderate fluctuations in the exchange rate.

The United States, Canada, Japan, and many other major trading nations use the managed floating system. From time to time, the individual countries intervene in the foreign exchange market, either on their own or in coordination with each other. In the late 1990's, most European Union (EU) countries agreed to adopt a common currency, the euro, in 1999 and thereby permanently fix exchange rates among themselves. The plan called for allowing the euro to float against the currencies of non-EU countries, subject to intervention by the European Union's central bank. Robert M. Stern

Balance of power is a system of maintaining peace through an even distribution of military and economic power among nations or groups of nations. It was an important principle of international relations from the 1500's to the 1900's. Countries achieved a balance of power by forming alliances so that no nation or alliance was strong enough to take over.

A balance of power system must have at least three powerful countries. If any nation gains too much power, the others form an alliance against it. In most cases, each member of an alliance agrees to defend any other member that is under attack. The strength of the alliance discourages attacks. During the early 1900's, for example, a balance of power existed between the six chief powers of Europe. Germany, Austria-Hungary, and Italy belonged to a group called the *Triple Alliance,* which opposed a group called the *Triple Entente,* consisting of the United Kingdom, France, and Russia.

A balance of power requires that nations be willing to form alliances with any country despite differences in political beliefs or goals. Such alliances may be short-term agreements. The nations involved usually build up their military and economic strength so no other nation can achieve an overwhelming military advantage. If one of the major nations is weakened by war, the entire balance of power system may collapse.

Bipolar and *multipolar systems* differ from a balance of power system. In a bipolar system, there are two major nations and most other countries side with one of the two. In a bipolar system, none of the countries can serve as power balancers. A multipolar system includes more than three major nations, each acting independently rather than in an alliance. Michael P. Sullivan

See also International relations (History).

Balance of trade. See Balance of payments.

Balanchine, *BAL uhn CHEEN,* **George** (1904-1983), was one of the most important ballet *choreographers* (dance creators) of the 1900's. He was also a founder and the artistic director of the New York City Ballet, one of the leading dance companies in the United States. He was

noted for his inventiveness and his ability to take a dance *phrase* (series of movements) and develop it in varied and surprising ways. He experimented with a quick, strong dancing style that was full of changes of direction. Balanchine sometimes used turned-in positions and flexed feet, instead of the usual turned-out positions and pointed feet.

Balanchine created more than 400 ballets of many different types. His ballets include traditional works, such as *Divertimento No. 15* (1956) and *Theme and Variations* (1947), which were based on music composed in the 1700's and 1800's. He also created experimental ballets, such as *Four Temperaments* (1946) and *Agon* (1957), both based on the music of more modern composers.

Balanchine was born on Jan. 22, 1904, in St. Petersburg, Russia. His real name was Georgi Melitonovitch Balanchivadze. He left Russia in 1924 and joined the ballet company of Sergei Diaghilev in Paris, becoming its leading choreographer. Balanchine came to the United States in 1933 and helped found the School of American Ballet. The school's performing company became the New York City Ballet in 1948. Katy Matheson

Balboa, *bal BOH uh,* **Vasco Núñez de,** *VAHS koh NOO nyayth day* (1475?-1519), a Spanish conqueror and explorer, was the first European to see the eastern shore of the Pacific Ocean. He sighted the ocean in late September 1513, from a mountaintop in what is now Panama. Soon afterward, on Sept. 29, 1513, Balboa waded into the ocean and claimed it and all its shores for Spain. His findings opened Spanish exploration and conquest along the western coast of South America.

The Spaniards called the ocean the South Sea because it lay south of the Isthmus of Panama, a strip of land that links North and South America. In 1520 and 1521, Portuguese explorer Ferdinand Magellan sailed across the ocean during a voyage for Spain. He named the ocean *Pacific,* meaning *peaceful.*

Early life. Balboa was born in Jerez de los Caballeros, Spain. His father, though perhaps a nobleman, had neither influence nor wealth. Young Vasco served in the household of a rich nobleman in Moguer, a port on Spain's southwest coast. After Christopher Columbus reached America in 1492, many ships heading for the New World took on sailors and supplies at Moguer. Sailors who returned to the port from America often told stories about the new lands across the sea.

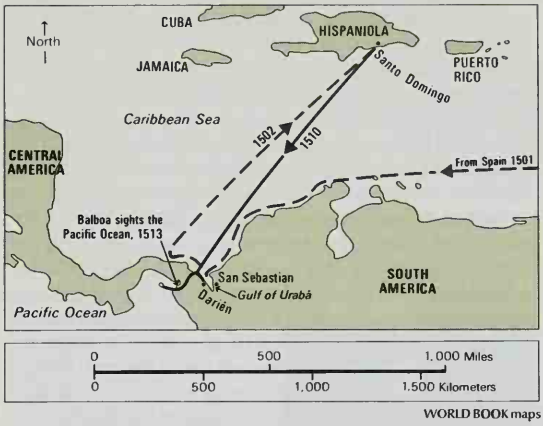
The opportunities for fame and wealth in the New World attracted Balboa. In 1501, he joined a Spanish expedition to South America. The party explored the north coast of the continent, including an area along the Gulf of Urabá in what is now Colombia. However, the expedition lacked enough people to attempt a settlement. In 1502 it sailed to the island of Hispaniola, the main Spanish base in America. Balboa had a hard time making a living on the island. For a time, he raised pigs there.

Rise to fame. In 1509, the first Spanish expedition to colonize the mainland of South America left Hispaniola. Balboa attempted to join the expedition. But he had fallen heavily into debt, and people to whom he owed money prevented him from leaving Hispaniola.

On the mainland, the Spaniards established the settlement of San Sebastián along the eastern side of the Gulf of Urabá. In 1510, Balboa stowed away on a ship that carried supplies and new settlers to the colony. After

Balboa's New World journeys

The larger map traces Vasco Núñez de Balboa's journeys in the Caribbean. Balboa helped establish the colony of Darién in 1510. In 1513, he led an expedition across the Isthmus of Panama and sighted the Pacific Ocean.



WORLD BOOK maps

Granger Collection

Vasco Núñez de Balboa was the first European to see the eastern shore of the Pacific Ocean. On Sept. 29, 1513, he waded into the ocean and claimed it and all its shores for Spain.

reaching the mainland, the new settlers met the survivors of San Sebastián, who had abandoned the settlement because of dangerous Indians and a lack of food. The two groups united and returned to San Sebastián briefly. Balboa, who probably had more experience on the continent than any of the other settlers, suggested moving to the western side of the gulf. He had seen the area during his first expedition and knew that the Indians who lived there were more peaceful. The Spaniards moved to the site and established the town of Santa María de la Antigua del Darién, usually called Darién.

Balboa became acting governor of Darién. He led expeditions into Panama, conquering some Indians and making agreements with others in the area. In 1511, Indians told Balboa of a land called Tubanama, where he could find much gold. According to the Indians, this land was located across the mountains near a great sea.

Balboa knew he had only a weak claim to the governorship of Darién, and so he wanted to please King Ferdinand of Spain. Early in September 1513, Balboa led an expedition from Darién. The group of 190 Spaniards and a large number of Indians followed Indian trails across the isthmus. During the third week of the trip, Balboa's Indian guides told him the ocean could be seen from a nearby mountain. Balboa, ordering his men to stay behind, advanced to the peak and sighted the Pacific.

The Spaniards found gold and pearls on the Pacific Coast. Balboa believed his findings would win him an appointment as permanent governor of Darién.

Later exploration. Before the news of Balboa's expedition reached Spain, Ferdinand appointed Pedrarias Dávila, an elderly nobleman, to be the new governor. Pedrarias, as he was called, arrived in Darién in 1514. Ferdinand finally heard of Balboa's findings and named him to serve under Pedrarias as governor of a new area on the Pacific coast of Panama. Balboa established the town of Acla on the north coast and transported materials across the isthmus to build ships for further conquest and exploration. The Spaniards completed two ships by 1518, and Balboa explored along the Gulf of Panama. He also considered an expedition to conquer the area now known as Peru.

Execution. Pedrarias grew increasingly jealous of Balboa, who had become a powerful figure with many supporters. In 1518, the governor falsely accused Balboa of treason and had him arrested. Pedrarias arranged for a speedy trial, and Balboa was sentenced to death. In January 1519, Balboa and four friends were beheaded in the public square of Acla. Helen Delpar

Additional resources

Ash, Maureen. *Vasco Núñez de Balboa.* Childrens Pr., 1990. Younger readers.

Romoli, Kathleen. *Balboa of Darién.* Doubleday, 1953. A standard biography.

Balch, *bawlch,* **Emily Greene** (1867-1961), an American economist and pacifist, was one of the winners of the Nobel Peace Prize in 1946. She helped form the Women's International Commission for Permanent Peace in 1915. She served from 1919 to 1922 as secretary of the Women's International League for Peace and Freedom, and became its honorary president in 1937. She taught at Wellesley College from 1896 to 1918. She was born in Boston. Nancy Woloch

Balchen, *BAHL kuhn,* **Bernt,** *burnt* (1899-1973), was a Norwegian-American aviation pioneer. He flew across the Atlantic Ocean with Richard E. Byrd in 1927, and was the chief pilot on Byrd's first Antarctic expedition. He piloted the first airplane over the South Pole on Nov. 29, 1929. He first gained experience in Arctic flying by serving with Roald Amundsen.

Balchen joined the U.S. Army Air Corps in 1941. Later, he commanded air operations against Germany in northern Norway during World War II. He was born in Tveit, near Arendal, Norway. William Barr

Bald eagle. See Eagle (with picture).

Baldcypress, *SY pruhs,* is a cone-bearing tree with pale-green, feathery leaves. It grows in wet areas and swamplands of the United States from Texas to New Jersey. It is a large tree, often with a fluted, tapering base. The roots of the tree produce growths called *knees* that protrude above the water (see **Louisiana** [picture: A baldcypress swamp]). The knees provide air for the roots. The crowns of young trees are shaped like a narrow pyramid, but old trees are flat-topped. Unlike most conifers, the baldcypress sheds its leaves each year. The wood is very durable. The baldcypress is the state tree of Louisiana. See also **Tree** (Familiar broadleaf and needleleaf trees [picture]).

Scientific classification. The baldcypress belongs to the baldcypress family, Taxodiaceae. Its scientific name is *Taxodium distichum.* Douglas G. Sprugel

Balder was the god of beauty, goodness, and light in Norse mythology. He was the most beloved of the Norse gods. Balder was the son of the chief god, Odin, and the goddess Frigg.

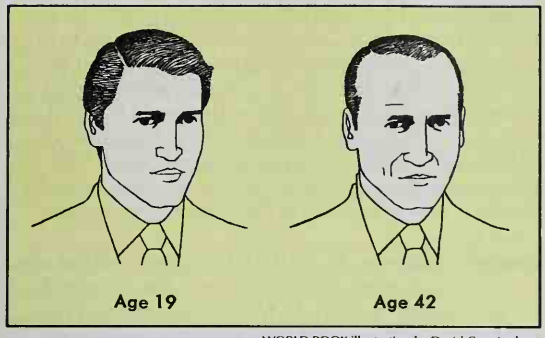
The most important myth about Balder concerns his death. Frigg had made all things—animals, plants, and even stones—swear an oath not to harm Balder. The gods amused themselves by throwing things at Balder because they knew he could not be hurt. But the evil god Loki learned that one plant, the mistletoe, had not sworn the oath. Loki gave the blind god Hoder a sprig of mistletoe and helped him throw it at Balder. The mistletoe pierced Balder's body and killed him.

The gods were grief-stricken by Balder's death. Hel, the goddess of the dead, sent word that Balder could be restored to life if all things wept for him. Everything began to weep except one giantess, who was really Loki in disguise. As a result, Balder must remain dead until *Ragnarok,* a great battle in which the world will be destroyed by fire. A better world will rise from the ashes, and Balder will return from the dead and help rule it. Carl Lindahl

Baldness is the partial or total absence of hair on the scalp. Some thinning of the scalp hair takes place as a normal part of the process of aging. However, many types of abnormal hair loss also occur.

Some kinds of baldness involve only a thinning of the hair or a loss of hair from one small area of the scalp. But in the most common type, called *male pattern baldness,* a man loses much or all of the hair over the top of the head. A smaller number of women have a condition known as *female pattern baldness.* This condition involves thinning of the hair but usually not complete baldness and begins later in life.

A healthy scalp sheds old hairs continually, and new ones grow to replace them. Baldness develops when



WORLD BOOK illustration by David Cunningham

Male pattern baldness involves the loss of hair on the top of the head. The loss may occur rapidly or over many years.

new hair stops growing for any reason. In male pattern baldness, hair loss results from the combination of an inherited trait and the effects of the hormone *testosterone*. Loss of hair may begin during the teen-age years or at any later time.

Pattern baldness cannot be cured. However, many types of baldness are temporary, and normal hair growth can be restored in many cases. Temporary baldness may be a symptom of many serious illnesses, of a skin infection, or of emotional stress. The use of certain drugs may also cause temporary baldness.

In male pattern baldness, heredity strongly influences the degree of hair loss and the age at which it begins. A man can inherit baldness from either his father or his mother. The exact pattern of inheritance is not known. The percentage of men who have male pattern baldness increases with age.

People may use any of several methods to cover bald areas. Many wear a hairpiece, such as a toupee or a wig. Others prefer *hair weaving,* a technique in which the sides of a hairpiece are sewed into the remaining hair. In a process called *hair transplanting,* a doctor surgically removes plugs of the scalp that contain growing hair. The plugs are then transplanted to the bald areas.

The drugs *minoxidil* and *finasteride* may stimulate hair growth in some people. Minoxidil (trade name Rogaine) is a scalp ointment that may maintain hair growth when applied regularly. Finasteride (trade name Propecia) is a pill that may stop hair loss or promote new growth of hair for some men. Because it can cause birth defects, finasteride is not approved for women. Robert S. Stern

Baldpate. See Wigeon.

Baldwin, Abraham (1754-1807), was a Georgia signer of the Constitution of the United States. At the Constitutional Convention of 1787, Baldwin's decision to vote with the small states in the dispute over representation in Congress brought about a tie among the delegates. He then helped draft the *Great Compromise* that settled the representation problem. See **Constitution of the United States** (The compromises).

Baldwin was born in North Guilford, Connecticut. He graduated from Yale College in 1772. Three years later, he became a minister and a tutor at Yale. During the Revolutionary War in America (1775-1783), he served as a chaplain in the army. After the war, Baldwin entered the legal profession.

In 1784, Baldwin moved to Georgia, where he served on the committee that helped found the state system of education. He helped establish Franklin College (now the University of Georgia).

In 1785, Baldwin became a member of both the Georgia Assembly and the Congress of the Confederation. He served in the United States House of Representatives from 1789 to 1799 and in the U.S. Senate from 1799 until his death. Joan R. Gundersen

Baldwin, James (1924-1987), was an African American novelist, essayist, and playwright. He gained fame for his works about racial conflict and injustice in the United States.

During the civil rights movement of the 1960's, Baldwin participated in and was a major literary interpreter of the struggles of black Americans. In the powerful essay collections *Nobody Knows My Name* (1961) and *The Fire Next Time* (1963), Baldwin expressed the reaction of blacks to racial discrimination.

Baldwin also expressed his views about interracial conflict in his fiction and dramas of the 1960's. The novel *Another Country* (1962) focuses on a black musician and his relationships with white lovers. The drama *Blues for Mister Charlie* (1964) examines the interracial tensions surrounding the murder of a black man by a white man in a Southern town. In the novel *Tell Me How Long the Train's Been Gone* (1968), Baldwin presented his most detailed analysis of black civil rights activities of the 1960's. Baldwin's racial attitudes are also reflected in the short stories collected in *Going to Meet the Man* (1965).

Stephen Hale, WTTW-TV

James Baldwin

Some of Baldwin's earlier works emphasize topics other than racial conflict. For example, his first novel, *Go Tell It on the Mountain* (1953), reveals the psychological problems of members of an African American family. Baldwin explored the subject of homosexuality in his next novel, *Giovanni's Room* (1956), and in other works of fiction.

James Arthur Baldwin was born in the Harlem district of New York City. He was a minister as a teen-ager, and much of his writing stresses the importance of developing satisfactory relationships with other people.

Nellie Y. McKay

Additional resources

Leeming, David. *James Baldwin: A Biography.* Knopf, 1994.
Standley, Fred L., and Burt, N. V., eds. *Critical Essays on James Baldwin.* G. K. Hall, 1988.

Baldwin, Matthias William (1795-1866), was an American inventor and philanthropist. In the early 1830's, he built *Old Ironsides,* one of the first American-made locomotives. Baldwin designed and built the locomotive with tools he had made especially for the task. He built it in six months. Made of iron and wood, the locomotive weighed 6 tons (5.4 metric tons). It could pull 30 tons (27 metric tons) at a speed of 28 miles (45 kilometers) per hour, an amazing speed at that time.

Baldwin's accomplishments were not limited to his

Smithsonian Institution

Old Ironsides, a locomotive designed and built by Matthias Baldwin, was made of iron and wood. It could travel up to 28 miles (45 kilometers) per hour. *Old Ironsides* remained in active service for more than 20 years in Pennsylvania.

work on locomotives. In 1819, he invented a simplified process of plating gold. He entered a manufacturing business in 1825. Later, he designed a process for printing designs on cloth and built a noiseless engine.

In 1832, Baldwin established the Baldwin Locomotive Works. From then on, he devoted his time to improving and building locomotives and stationary engines. In 1842, he patented a locomotive design that solved the problem of moving around curves.

Baldwin was born on Dec. 10, 1795, in Elizabethtown, New Jersey. He became interested in tools and mechanical devices when he was apprenticed to a jeweler during his youth. Baldwin helped found the Franklin Institute and a school for black children. Robert C. Post

Baldwin, Robert (1804-1858), served twice as joint premier of the Province of Canada. He and Louis H. LaFontaine held office as premiers from 1842 to 1843 and from 1848 to 1851.

In 1848, Baldwin and LaFontaine gained a parliamentary form of government for the Province of Canada. Under this form of government, the leaders of the majority party in the elected Legislative Assembly controlled the province. Before 1848, a governor appointed by the British government held power. His supporters in the Legislative Council, the upper house of the provincial government, had often blocked legislation passed by the Assembly. In 1850, Baldwin helped transform King's College, an Anglican school, into the University of Toronto.

Baldwin was born on May 12, 1804, in York, Upper Canada (now Toronto, Ontario). In 1836, he was appointed to the Executive Council of Upper Canada, which advised the British governor. He was named to the Province of Canada's Executive Council in 1841. He resigned from both councils when the British governors opposed his efforts to gain parliamentary government. William Ormsby

Baldwin, Stanley (1867-1947), served as prime minister of Britain three times. His leadership in the Conservative revolt against David Lloyd George in 1922 led to his selection as prime minister in 1923 (see **Lloyd George, David**). His proposal for tariff reform brought his defeat early in 1924.

Ten months later, Baldwin returned to power. He effectively handled the General Strike of 1926, a strike in sympathy for coal miners facing longer hours and less pay. Baldwin was defeated in 1929 after failing to deal successfully with unemployment. He served his third term from 1935 to 1937 and handled the abdication of Edward VIII in 1936 with great skill (see **Edward VIII**). Baldwin was born on Aug. 3, 1867, in Bewdley, England, in what is now the county of Hereford and Worcester. Keith Robbins

Balearic Islands, *BAL ee AR ihk,* is a group of five major islands and numerous smaller ones that lie east of the mainland of Spain in the Mediterranean Sea. Palma is the capital of the islands, which form a province of Spain. See **Spain** (terrain map).

The islands have a population of about 709,000 and an area of 1,936 square miles (5,014 square kilometers). Majorca, the largest island, has fine harbors. But in general, the islands have rugged coasts. A mild climate and the islanders' relaxed way of life have made the islands a major tourist center. Grapes, olives, oranges, grapefruit, and other fruits flourish there. Manufactured goods are also important, especially in Majorca. They include shoes, ceramics, and metalware.

The Iberians, Phoenicians, Greeks, Carthaginians, Romans, and Byzantines all occupied the islands. A regiment of Balearic islanders became famous as stone-slingers in Julius Caesar's armies. In the late 700's, the Moors invaded the islands. About 1230, Aragon (now part of Spain) took all the islands except Minorca (taken in 1287). Edward Malefakis

See also **Majorca; Minorca.**

Baleen. See **Whale.**

Balfour, Arthur James (1848-1930), Earl of Balfour, served as British prime minister from 1902 to 1905, and was a leader of the Conservative Party for over 20 years. Two famous declarations bear his name. One in 1917 dealt with British support for Palestine as a national home of the Jews (see **Balfour Declaration**). The other was the report of the 1926 Imperial Conference, which defined the British Commonwealth of Nations as a free association of countries equal in rank.

Balfour served as foreign secretary in the coalition war Cabinet of David Lloyd George from 1916 to 1919. He was lord president of the council from 1919 to 1922 and from 1925 to 1929 (see **Privy Council**). In 1922, Balfour was knighted and became a member of the House of Lords.

Balfour was born on July 25, 1848, on his family's estate, Whittinghame (now Whittingehame), near Edinburgh in Scotland. He attended Eton College and Cambridge University. He was first elected to Parliament in 1874, and served as the first secretary for Scotland in 1886, chief secretary for Ireland from 1887 to 1891, and first lord of the treasury from 1895 to 1902. Keith Robbins

Balfour Declaration was a British government document that dealt with the establishment of a Jewish homeland in Palestine. British Foreign Secretary Arthur James Balfour issued it in 1917. The meaning of the Balfour Declaration was interpreted differently by Arabs and Jews, who both claimed the Palestine region. The document led to a bitter controversy that helped set the stage for continuing conflicts between Arabs and Israelis in the Middle East.

The Balfour Declaration read as follows: "His Majesty's Government view with favour the establishment in Palestine of a national home for the Jewish people, and will use their best endeavors to facilitate the achievement of this object, it being clearly understood that nothing shall be done which may prejudice the civil and religious rights of existing non-Jewish communities in Palestine, or the rights and political status enjoyed by Jews in any other country."

When the Balfour Declaration was issued, during World War I, British forces were fighting to win Palestine from the Ottoman Empire. The United Kingdom wanted to control Palestine because of its location near the Suez Canal, which links the Mediterranean Sea and the Red Sea. The British believed the Balfour Declaration would help gain support of this goal from Jewish leaders in the United Kingdom, the United States, and other countries. In 1922, the League of Nations endorsed the Balfour Declaration and officially approved the United Kingdom's *mandate* (order to rule) over Palestine.

Jews who supported the establishment of a Jewish national homeland in Palestine believed the Balfour Declaration pledged British support for their goal. But leaders of a growing Arab nationalism movement in Palestine claimed the declaration allowed for such a homeland only if Arabs agreed to it. The British withdrew from Palestine in 1948. At the same time, Jews in the formerly mandated area established the independent nation of Israel, despite strong Arab opposition. The Arab-Israeli dispute over Palestine made the area a world trouble spot. For more details on the Balfour Declaration and its results, see **Palestine.** Ellis Rivkin

See also **Balfour, Arthur James; Israel** (History); **Jordan** (The Palestinian conflict); **Zionism.**

Baline, Israel. See **Berlin, Irving.**

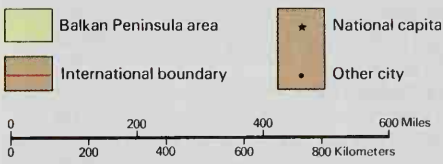
Balkans are a group of countries that cover a peninsula in the southeast corner of Europe. *Balkan* is a Turkish word meaning *mountain.* The Balkans include several mountain ranges. The region has been called the *Powder Keg of Europe* because many wars began there.

Location, size, and description. The Sava and Danube rivers form the northern boundary of the Balkan Peninsula. The Black Sea and the Bosporus border it on the east. The southern boundary is formed by the Sea of Marmara, the Dardanelles, and the Aegean Sea. The Adriatic and Ionian seas lie on the west.

The Balkan Peninsula covers about 184,000 square miles (477,000 square kilometers). It includes Albania, Bosnia-Herzegovina, Bulgaria, Macedonia, the mainland of Greece, the European part of Turkey (eastern Thrace), and parts of Croatia, Slovenia, and Yugoslavia. Most of Romania is not a geographic part of the peninsula. But Romania is often considered a Balkan country because of its close ties with the region in history and politics.

Balkans

These maps show the states of the Balkan Peninsula before the outbreak of the First Balkan War in 1912, *below left,* and as they are today, *below right.* In 1912, the Ottoman Empire still had large possessions in Europe, including what is now Albania, Macedonia, and parts of Bulgaria, Greece, and Yugoslavia. After the Balkan Wars, the Ottoman Empire, which later became Turkey, lost all its European possessions except eastern Thrace.



The Balkan Peninsula before the Balkan Wars (1912-1913)

The Balkan Peninsula today

WORLD BOOK maps

Mountains cover much of the peninsula. The Dinaric Alps extend through Croatia along the Adriatic Sea to Greece, where they are called the Pindus Mountains. The Balkan Mountains stretch from the eastern border of Yugoslavia across Bulgaria. The Rhodope Mountains rise in southern Bulgaria. The Danube River is the area's chief commercial waterway. Other important rivers are the Morava, Vardar, and Maritsa.

People. The chief nationalities of the Balkan Peninsula include Albanians, Bosniaks, Bulgarians, Croats, Greeks, Macedonians, Romanians, Serbs, and Turks. About half of the peninsula's people live in rural areas, and about half live in urban areas. The major cities are Athens, Greece; Belgrade, Yugoslavia; Bucharest, Romania; Istanbul, Turkey; Sarajevo, Bosnia-Herzegovina; Sofia, Bulgaria; and Thessaloniki, Greece.

Early history. The Roman Empire held the peninsula for over 500 years, beginning about 148 B.C. The Slavs came into the area in the A.D. 500's. By the late 1300's, the Ottoman Empire held most of the peninsula.

In the 1800's, the Balkan peoples, spurred by feelings of nationalism, began to seek independence. The great European powers—including Austria-Hungary, France, and the United Kingdom—encouraged Balkan nationalism for their own purposes. From 1829 to 1908, first Greece and then Montenegro, Serbia, Romania, and Bulgaria gained their independence from the Ottoman Empire. But all the people of one nationality did not live in the same country. The Congress of Berlin in 1878 recognized the independence of Montenegro, Romania, and Serbia. The Ottoman Empire continued to hold Macedonia and Albania.

The First Balkan War. The newly independent states wanted to free the entire Balkan Peninsula from Ottoman rule. In October 1912, war broke out between the Ottoman Empire and four of the Balkan states: Bulgaria, Greece, Montenegro, and Serbia. In November, Albania declared its independence from the Ottoman Empire. The Ottomans asked for a truce in December.

The Balkan countries demanded that the Ottomans withdraw from almost all of their European possessions. The empire refused, and the war resumed in February 1913. The coalition defeated the Ottoman Empire, and on May 30, 1913, the empire signed the Treaty of London, giving up nearly all its territory in Europe. Albania was recognized as an independent country. Bulgaria took Adrianople (now Edirne, Turkey). Serbia gained large areas in Macedonia. Greece gained Crete and other islands, Thessaloniki, and part of Macedonia.

The Second Balkan War. Bulgaria had done most of the fighting against the Ottomans. However, it did not receive as much territory in Macedonia as it had been promised in a secret treaty of alliance before the war. Serbia had taken control of the promised territories during the war and did not want to give them up. So Bulgaria attacked Serbian and also Greek positions in Macedonia in June 1913. Romania, Montenegro, and the Ottoman Empire then joined the Serbs and the Greeks in fighting the Bulgarians.

Less than a month after the fighting started, the Bulgarians asked for peace. Under the Treaty of Bucharest, signed on Aug. 10, 1913, Bulgaria lost much of the territory it had taken from the Ottoman Empire in the first war, keeping only western Thrace and a small corner of Macedonia. The Ottomans regained Adrianople, with eastern Thrace. The Balkan wars sowed deep bitterness among the people of Macedonia and Bulgaria. Albanians in the Kosovo region of Serbia also felt wronged, because they came under Serbian rule despite their desire to be part of the new country of Albania.

World War I (1914-1918) started in the Balkan Peninsula. Bulgaria and the Ottoman Empire were the only Balkan powers on the side of Germany and Austria-Hungary. France became a leading ally of the Balkans during the war. See **World War I**.

After the war, Serbia, Montenegro, and territories north of them were combined into a kingdom that later became Yugoslavia. The Ottoman Empire was abolished in 1922, and the nation of Turkey was formed in 1923 from the empire's remaining territories.

World War II (1939-1945). Bulgaria joined Germany and Italy in World War II. Bulgaria occupied the Yugoslav (Serbian) part of Macedonia and a part of northern Greece. Germany and Italy occupied the rest of Greece and Yugoslavia. Albania was occupied by Italy and later by Germany. Turkey remained neutral during most of the war. Until October 1944, Germany and Italy controlled most of the peninsula. See **World War II**.

After World War II, all the Balkan countries except Greece and Turkey fell under Communist rule. Greece and Turkey became allies of the United States and members of the North Atlantic Treaty Organization (NATO).

Communist rule. The Communist governments in Albania, Bulgaria, Romania, and Yugoslavia closely followed the model of the Soviet Union. These governments took control of industry and, except for Yugoslavia, of agriculture. They outlawed all political parties other than the Communist party, imposed censorship, conducted antireligious campaigns, and used secret police to enforce obedience. In Greece, Communist rebels fought for nearly five years to seize control of the country, but they were finally defeated.

Yugoslavia's leader, Josip Broz Tito, refused to let the Soviet Union control his country. In 1948, Soviet leader Joseph Stalin expelled Yugoslavia from the Soviet-led Cominform organization and cut all ties between the countries. After Stalin's death, the two countries reestablished relations, but Yugoslavia remained independent.

By the end of the 1970's, the Balkan states faced high unemployment and civil unrest. In the late 1980's and early 1990's, Communist governments throughout Europe collapsed. Albania, Bulgaria, Romania, and Yugoslavia adopted multiparty political systems.

Recent developments. In Yugoslavia, the Serbian leader Slobodan Milošević sought to extend Serbia's dominance. In 1991 and 1992, four republics of Yugoslavia—Bosnia-Herzegovina, Croatia, Macedonia, and Slovenia—declared their independence. War broke out between Serbs and non-Serbs, and Yugoslavia broke apart. Milošević and others waged violent campaigns for ethnic domination. In 1999, NATO air strikes helped end Serbian military attacks on ethnic Albanians in Kosovo. In 2000, Milošević lost power, and in 2002 he was put on trial before an international court for war crimes. For details, see the articles on the individual Balkan countries. Sabrina P. Ramet

Related articles in *World Book* include:

Albania
Berlin, Congress of

Bosnia-Herzegovina
Bulgaria
Crete
Croatia
Greece
Macedonia (country)
Montenegro
Romania
Serbia
Slovenia
Thessaloniki
Thrace
Turkey
Yugoslavia

Balkhash, Lake. See Lake Balkhash.

Ball. See the separate articles on ball games listed in the *Related articles* of the **Sports** article.

Ball, Lucille (1911-1989), was one of the most popular comediennes in the history of American television. She gained fame as the zany heroine of the TV comedy series "I Love Lucy" (1951-1957), co-starring her husband, Desi Arnaz. She continued the same type of character in the television comedy series "The Lucy Show" (1962-1968) and "Here's Lucy" (1968-1974). She and Arnaz founded Desilu Productions, one of the most profitable United States TV production companies.

UPI/Bettmann

Lucille Ball

Ball was born near Jamestown, New York, and began her career as a model. In the early 1930's, she moved to Hollywood. She made her film debut in 1933, playing small parts in musicals and comedies. In the 1940's, her movie roles grew bigger and more varied, though she was still known as a comic actress. In 1940, she married Arnaz, a Cuban bandleader. They were divorced in 1960. *Love, Lucy*, an autobiography, was published in 1996, after her death. Louis Giannetti

Ball bearing. See Bearing.

Ballad is a song that tells a dramatic story in verse. Ballads are one of the oldest forms of poetry and one of the oldest kinds of music. The term *ballad* may refer to any story told in song. But most ballads are folk songs or imitations of such songs. In the Middle Ages, singing poets called *minstrels* wandered over Europe, performing ballads in castles and villages (see **Minstrel**).

Ballads began thousands of years ago among people who could not read or write. The first ballads were performed with folk dances. Often, one person sang the story and dancers joined in on the refrain. Subjects of ancient ballads may have been the same gods and godlike heroes who were in myths and epics. Later, singers replaced the gods with new heroes, including the legendary English outlaw Robin Hood and the American railroad engineer Casey Jones.

The ballad style. Ballads have been created in many verse forms, but the most typical form in English has been the four-line stanza. An example is the first stanza of the ballad "The Wife of Usher's Well":

> There lived a wife at Usher's Well
> And a wealthy wife was she;
> She had three stout and stalwart sons,
> And sent them o'er the sea.

In the stanza, the first and third lines have four beats. The second and fourth lines have three. This pattern is called *common measure* (see **Poetry** [Rhythm and meter]).

The opening stanza of most ballads introduces the characters and a situation in a few vivid phrases. The situation involves a problem or some danger that creates suspense and stirs interest.

Ballads and literature. During the 1700's, authors and scholars began taking an interest in ballads they had heard sung. Thomas Percy, an English scholar, collected many ballads in his *Reliques of Ancient English Poetry* (1765). This collection was the first serious attempt to preserve the ballads of English and Scottish folk singers. It included the first published versions of the famous ballads *Sir Patrick Spens* and *Edward, Edward.* As a result of Percy's collection, writers began to appreciate the literary quality of ballads. Many important poets of the English romantic movement adopted the ballad form.

In the 1900's, such poets as W. H. Auden, Stephen Vincent Benét, and John Crowe Ransom wrote in the ballad form. Some popular American singers, including Johnny Cash and Bob Dylan, composed songs that imitate traditional ballads. But few ballads created by one individual have the powerful simplicity of those performed and refined by generations of singers. Paul B. Diehl

See also **Literature for children** (Folk literature).

Ballade, *buh LAHD,* is an elaborate, carefully patterned verse form. A typical ballade has three eight-line stanzas, each with the same rhyme scheme. These stanzas are followed by a four-line postscript called the *envoi,* or *envoy.* Each stanza and the envoi end in an identical one-line refrain. Repeated rhyming words and the repetition of a single theme in the refrain create a ballade's effect.

The ballade originated in France in the 1300's. The greatest writer of ballades was the medieval French poet François Villon. In 1869, the English poet Dante Gabriel Rossetti translated Villon's haunting "Ballade of Dead Ladies." In Rossetti's version, the poem's stanzas and envoi end with the famous refrain, "But where are the snows of yester-year?"

The ballade should not be confused with a ballad, which is a type of simple poem that usually tells a story. A ballade is also a music form. The Polish composer Frédéric Chopin first used the term in the 1800's to describe instrumental pieces that combined a lyrical quality with dramatic subject matter. William Harmon

Ballard, Robert Duane (1942-), is an American oceanographer who has advanced underwater exploration. His most famous discovery was the shipwrecked luxury liner *Titanic* in 1985. Ballard has helped design deep-sea research vehicles known as *submersibles.* In the early 1980's, he developed *Argo-Jason,* a remotely controlled submersible with video cameras and a detachable robot that could collect samples.

In 1974, as a member of Project FAMOUS (French-American Mid-Ocean Undersea Study), Ballard studied the underwater mountain chain called the Mid-Atlantic Ridge. In 1977, Ballard and other explorers found hot water vents in the Pacific sea floor. These vents supported whole communities of unknown living organisms. Ballard's Jason Foundation for Education, a nonprofit organization, educates students through such science projects as live underwater video "field trips."

Ballard was born in Wichita, Kansas, but grew up in California. He holds a B.S. degree from the University of California at Santa Barbara and a Ph.D. from the University of Rhode Island. Charles Pellegrino

© Jack Vartoogian

A classical ballet combines graceful, skilled dancers with beautiful music and elaborate scenery. *The Sleeping Beauty, above,* ranks among the most popular works in ballet. This production features dancers from the United Kingdom's Royal Ballet, one of the world's best-known companies.

Ballet

Ballet is a form of theatrical dance that uses formal, set movements and poses characterized by elegance and grace. Ballet dancers usually hold their bodies straight and lifted up. Ballet technique is based on positions in which the dancer's legs rotate outward from the hip joint and the feet turn outward. This rotation is called *turnout.*

An individual work or performance is called a ballet if it features ballet dancing. A ballet may tell a story, express a mood, illustrate the music that accompanies it, or simply portray movement. A ballet may consist of a full-length story, or it can be made up of short works, often in different styles. Ballets are sometimes included in other theatrical works, such as musical comedies and operas. *Choreographers* (creators of dances) arrange the steps and movements that form the complete work.

Ballet is a living art that can vary from performance to performance. Different dancers bring different qualities to their roles. The production will be affected by the harmony among performers, especially between the principal male dancer and the *ballerina* (leading female dancer). Throughout ballet history, some remarkable partnerships have developed, such as the one that began in the 1960's between Russian-born dancer Rudolf Nureyev and English ballerina Dame Margot Fonteyn. These pairings emerge when the partners show a particular understanding of each other, look good together physically, and perform in a complementary way.

Although dancing is the most important feature of a ballet, the presentation usually includes music, scenery, and costumes. Many ballets are collaborations among choreographers, set and costume designers, and composers. Ballets are performed by groups called *companies* or *troupes.* The *artistic director* of the company selects the *repertory* (ballets to be performed). The artistic director may also be the troupe's choreographer.

Ballet dancers perform many movements that are difficult for the body. However, when these movements are well executed, they look easy. Ballet dancers have always been known for their ability to control their bodies. Skilled dancers can perform complex turns, make magnificent leaps, and maintain control whether moving slowly or with great speed. Some dancers are also known for their dramatic and expressive skills or for their sensitivity to the phrasing of the music.

Ballet has become increasingly athletic over time, requiring greater flexibility and strength. Male dancers were once known primarily for their leaps, turns, and skills at partnering ballerinas. Now men have gained recognition for flexibility, high leg kicks, and other feats rarely attempted by earlier dancers. Female dancers were once known largely for dancing *on point* (on their toes) with the support of special shoes. Now female dancers also perform strong, complex leaps.

Training for ballet

The ideal ballet dancer has a well-proportioned body, with long legs and a slender torso. A dancer needs flexi-

Terms used in ballet

WORLD BOOK illustrations by Linda Worrall, Bernard Thornton Artists

Adagio, *uh DAH joh* or *uh DAH zhee oh,* is a series of slow, sustained movements in a ballet lesson to develop balance, line, and grace. It is also a slow dance in which the female partner performs difficult feats of balancing.

Arabesque

Allegro, *uh LAY groh* or *uh LEHG roh,* is a series of quick, lively movements.

Arabesque, *ar uh BEHSK,* is a pose in which one leg is raised and extended with a straight knee either in front of or behind the dancer, with the arms held in any of various positions.

Attitude is a pose in which one leg is raised and bent either behind or in front of the dancer with the knee higher than the foot.

Attitude

Ballerina is a leading female dancer.

Barre, *bahr,* is a round wooden or metal rod that may be attached to a studio wall, or freestanding and portable. Dancers use the barre for support during ballet exercises.

Center work is the series of exercises performed in the second half of a class, without the support of a barre.

Choreography, *kawr ee AHG ruh fee,* is the arranged movements that make up a ballet. The creator of the movements is a *choreographer.*

Corps de ballet, *KAWR duh ba LAY,* is the group of dancers who perform as an ensemble.

Danseur, *dahn SUR,* is a male dancer.

Divertissement, *dee vehr tees MAHN,* is a series of dances designed to show technical skill. It is inserted into many story ballets, but it is not necessarily related to the plot.

Entrechat, *ahn truh SHAH,* is a jump in which the dancer rapidly crosses the legs in front of and behind each other a number of times.

Jeté, *zheh TAY,* is a jump from one foot to the other with an outward kick of the leg. A *grand jeté* is a large forward leap, passing from one foot to the other.

Pas de deux, *pah duh DU,* is a dance for two people, usually a man and a woman.

Pirouette, *pihr u EHT,* is a full turn completed on one foot.

Plié, *plee AY,* is a bend of the knees. It is one of the most basic exercises in a ballet class.

Point work is dancing on the tips of the toes with the support of special ballet shoes.

Grand jeté

Port de bras, *pawr duh BRAH,* is the technique of moving the arms. It is also the name of the exercise through which this technique is developed or displayed.

Relevé, *ruh luh VAY,* is raising the body by lifting the heels.

Révérence, *ray vay RAHNS,* is a bow or series of bows at the end of a class.

Rond de jambe, *rawn duh ZHAHNB,* is a ballet exercise in which one leg makes a circling motion on the floor or in the air.

Tendu, *tahn DOO,* is a ballet exercise in which the foot is "stretched" away from the body but still touches the floor.

Turnout is the basic position of the legs and feet in ballet. The legs are completely turned outward, with the feet forming a straight line with the heels together.

Tutu is a ballerina's skirt. It is made of layers of net fabric.

Pirouette

Plié

Martha Swope

Partnering brings together a principal male dancer and a ballerina. The partners often display their skills in a specially choreographed duet within a ballet called a *pas de deux, shown here.*

bility, strength, discipline, and control. The dancer also must have a good sense of rhythm and musical phrasing plus dramatic expressiveness. However, many ballet dancers do not start with ideal bodies. They work hard for years to achieve the physical qualities needed for ballet.

Ballet requires years of training that should begin when the dancer is a child, usually about 8 years old. Dancers continue to take classes throughout their careers to maintain their skills.

The ballet teacher. In choosing a teacher, the student or parent should carefully consider the instructor's background and experience. Teachers without the proper qualifications can cause the student harm, and even physical injury. Poor teaching will delay a dancer's progress, forcing him or her to unlearn the incorrect lessons before mastering proper technique. Many teachers are active or retired performers. However, good teachers need not have been ballet dancers themselves.

Some ballet companies operate their own schools, training students for eventual membership in the company. They usually admit children as students after auditions. Other companies hold classes open to the public.

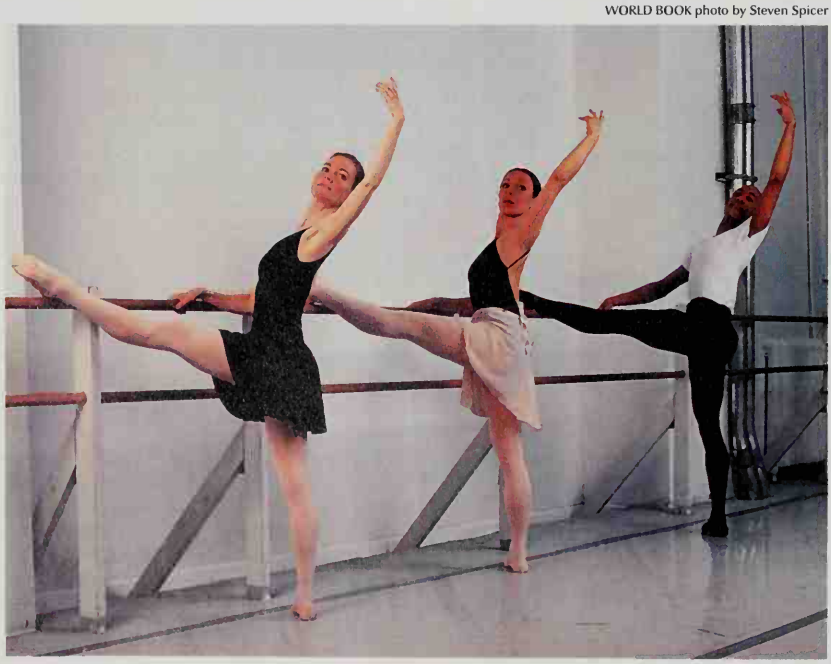
The ballet studio. A ballet class typically takes place in a special studio designed for ballet dancers. The best studios have a flexible wooden floor, which is less jarring to a dancer's body than a concrete surface. The studio should provide unobstructed spaces, plentiful mirrors, and wooden or metal rods called *barres* that are attached to a wall. A barre can also be free-standing and portable. Dancers use the barre for support.

A ballet class usually lasts about 90 minutes. Ideally, a class will have live music to accompany the dancers during their exercises. Often, recorded music is used.

The class normally begins with exercises at the barre. Time spent on the barre varies, depending on the goals of the class. Sometimes barre work occupies most of the class time. It may also serve merely as a quick warm-up. The work at the barre is the most basic part of a dancer's training, and it is a daily routine for professional dancers.

The first exercise will usually include *pliés* (knee bends) at various depths and in various positions. Other exercises include *tendus*, in which the leg is extended and the foot is stretched to a point position while in contact with the floor, and *relevés*, in which the dancer raises the feet from a flat to a point or half-point position.

WORLD BOOK photo by Steven Spicer



A ballet studio is equipped with metal or wooden rods called *barres* that are attached to a wall. Dancers use a barre for support while they practice. A studio also includes mirrors and a flexible wooden floor. The studio should provide enough space to allow the dancers to work without interfering with each other.

Dancers also practice traditional arm movements known as *ports de bras,* either separately or combined with other exercises. The exercises are designed to warm up the muscles, loosen the joints, build strength, and increase the dancer's coordination. The activities will increase in complexity and range as students advance in their knowledge and ability.

The second part of the class is devoted to *center work,* which takes place in the center of the studio, without the support of the barre. Dancers first perform slow combinations to test their balance and to build strength. These combinations include exercises in shifting from one foot to the other, changing the direction of the body in space, and moving the arms through *ports de bras.* Center work may include an *adagio,* a long slow combination that frequently involves large slow movements of one leg while balancing on the other. The dancers may also practice ballet turns. Center exercises usually build in speed and end with *allegro* work, which consists of fast and lively jump combinations.

Near the end of the class, dancers move across the floor and practice steps, turns, and jumps. A class traditionally concludes with dancers returning to the center of the floor. They perform a brief bow or series of bows called *révérence* to thank their teacher and the accompanist for the class.

In addition to basic ballet classes, advanced dancers may also attend special classes in such skills as partnering techniques and point work. They may also study other styles of dance and movement, such as folk dancing and pantomime.

Point work. Traditionally, point work has been reserved for female dancers. Some male dancers study it, though performing opportunities are limited to a few character or comic roles or to troupes in which men perform female roles.

A student usually needs at least three years of study to gain sufficient strength for point work. The dancer should be old enough to ensure that the feet have developed sufficiently. Point work is danced with special shoes that provide foot support, but the technique still requires knowledge, skill, and strength. Beginning students usually start with simple exercises that are part of regular classroom routine. They wear point shoes for only part of the class. As they advance, students attend classes devoted entirely to point work.

A dancer's life

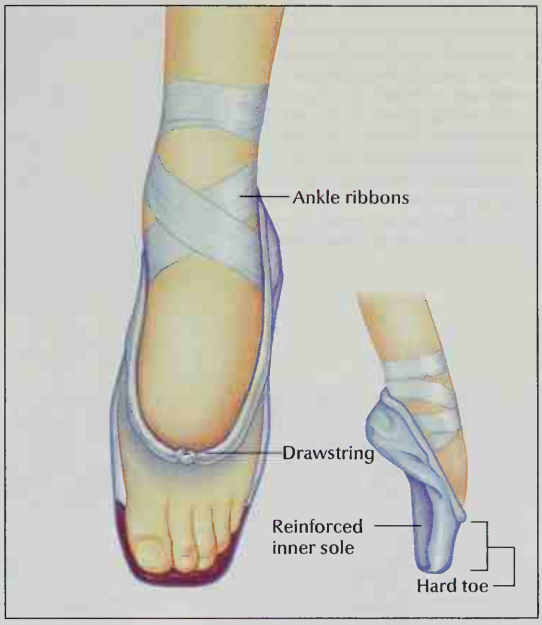
A ballet career can offer enormous satisfaction, but it is also strenuous and difficult. Job opportunities for ballet dancers are limited and salaries are low, except for a few superstars. Performing careers tend to be short, and dancers are always vulnerable to injury. Although some performers dance for many years, ballet is basically for young adults.

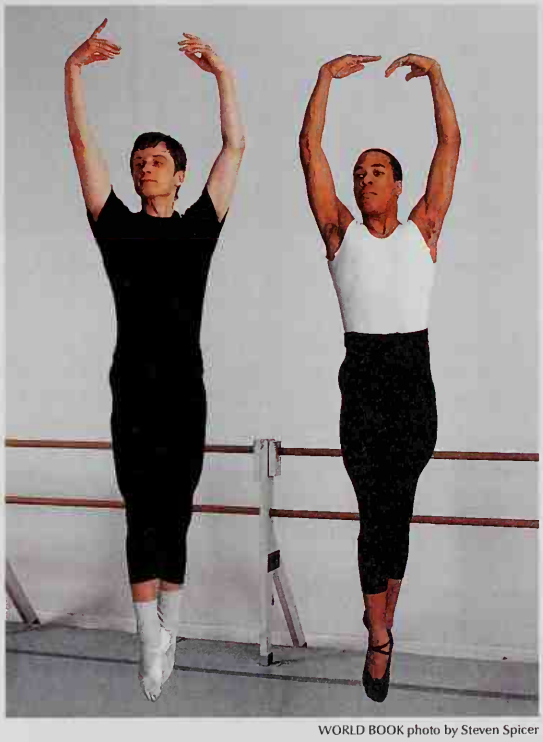
After the first years of training, students preparing for a professional career may take three to six ballet classes a week. Professional dancers try to attend at least one class a day. It can be difficult to combine ballet training with regular school. Many young dancers interested in a professional career choose to skip or postpone college. They believe the college years from the late teens to the early 20's are too valuable in the short career of a dancer to devote the time to anything but ballet.

Design of a ballerina's shoe

A ballerina's point shoe is handmade from leather or canvas and covered with satin. The shoe is fastened onto the foot with ankle ribbons. Additional support comes from a reinforced inner sole. The hard toe is a layer of fabric mixed with special glue.

WORLD BOOK illustrations by Barbara Cousins





WORLD BOOK photo by Steven Spicer

Center work usually follows warm-ups at the barre in a ballet class. The dancing takes place in the center of the studio. Small groups of dancers practice jumps, turns, and other exercises.

The five ballet positions

Every ballet movement and pose begins with the feet in one of five positions. The legs and feet should be turned out from the hip in each position to permit greater freedom of movement. The toes should be flat on the floor. When the heels are flat on the floor, the body weight should be balanced equally on both legs. There are also five positions of the arms. The proper arm position should produce a clear line that runs from the shoulder to the fingertips. The pictures on this page illustrate the most common combinations of feet and arm positions. Beginning ballet students should memorize the five positions of the feet and arms. They cannot begin training without this knowledge.

1st position

2nd position

3rd position

4th position

WORLD BOOK photos by Steven Spicer

5th position

After dancers retire, some become teachers or rehearsal directors who help stage ballets. Others may become dance administrators, designers, historians, physical therapists, photographers, or critics. Some become *notaters*—that is, people who preserve ballets by writing down the patterns and steps through a system of graphic symbols.

Kinds of ballet

The most familiar type of ballet is the full-length story ballet. Many of the great story ballets originated in the 1800's. One example is *Coppélia* (1870), choreographed by Arthur Saint-Léon to music by Léo Delibes, both of France. Another is *The Nutcracker* (1892), created by Lev Ivanov to music by Peter Ilich Tchaikovsky, both of Russia. These ballets have *librettos* (stories) that were created specially for the work. Many ballets use existing stories. For example, fairy tales are the basis for *The Sleeping Beauty* (1890) by Marius Petipa, a French-born choreographer who worked in Russia, and *Cinderella*, in versions by several choreographers. *Daphnis and Chloë* (1912) by the Russian-born choreographer Michel Fokine is adapted from an ancient Greek story.

Story ballets typically have two or more acts separated by intermissions. They usually feature elaborate sets and costumes and often include pantomime as well as different types of dancing. Sometimes all the dancing relates to the story. In some ballets, a *divertissement* may be injected. A divertissement is a dance segment intended to display a dancer's technical skill. Many story ballets are love stories. Most such ballets feature dramatic solos and romantic *pas de deux* (duets) by the principal dancers, who play the lovers.

A ballet program may consist of several shorter works, which may vary greatly in style and scope. Some shorter ballets describe a brief incident rather than tell a complete story. Some poetic ballets evoke moods and meanings without telling a story. A ballet may be in-

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The choreographer, *center,* creates a ballet by arranging the steps and other movements that form the complete work. A choreographer also teaches the movements to the dancers. Some ballet companies employ a resident choreographer who is responsible for creating new ballets for the troupe's repertoire.

spired by images or events from daily life or from art and music. Ballets may focus purely upon movement. They may explore the shapes, forms, and energies that belong uniquely to ballet, or they may utilize other dance styles. A ballet may set out purely to entertain, or it may try to deal with serious social issues.

Choreography

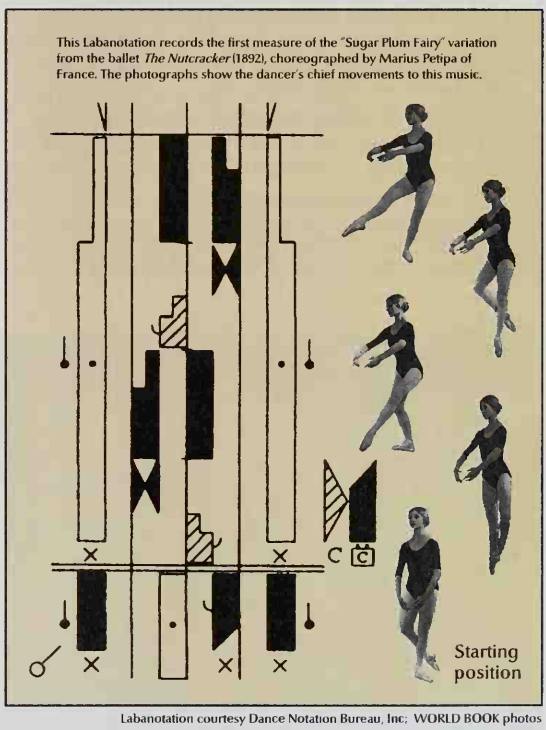
Choreographers vary in how they create a ballet. Some create material on their own. Others come to rehearsal with only a general idea of what they want, and they then work with the dancers to develop the ballet. Choreographers must consider the scenery, costumes, and music and how these elements will fit the dancing.

Often a company's repertory will consist of works by different choreographers. Some troupes employ a resident choreographer who is responsible for creating new ballets. The most successful works often come from choreographers who work with a group of dancers over time. Frequently a dancer will be a source of inspiration for a choreographer.

Sets and costumes

A ballet's sets and costumes are often designed by the same person. Some famous artists have designed ballets, including the Spanish-born painters Pablo Picasso and Salvador Dali. Painted backdrops and side panels have traditionally been the setting for ballets. Many modern designs have employed simple structures or scenic effects created with lighting alone. Occasionally, a designer uses film or video projections. The most successful designs create mood without obstructing the stage space the dancers require.

Costumes have changed during the history of ballet, and the changes have affected how the dancers move. In the early days of ballet, female dancers wore heavy skirts



Labanotation courtesy Dance Notation Bureau, Inc; WORLD BOOK photos

Labanotation is a system of recording all the movements in a ballet. The center vertical line in the diagram above represents the center of a dancer's body. The symbols to the left of the line stand for movements of the left side of the body, and the symbols to the right stand for those of the right side. The distance from the center line indicates the part of the body to be moved, and the shape of each symbol indicates the direction of movement. The symbol's length specifies the speed of movement.

that reached the floor. During the 1800's, ballerinas began to wear skirts called *tutus*, made of lightweight net. Those tutus that extended below the knee were known as *romantic tutus*. *Classical tutus* were much shorter, often reaching no lower than the top of the thighs. Since the early 1900's, shorter and lighter costumes have allowed dancers more freedom to carry out complex movements. Today, dancers sometimes perform in close-fitting leotards and tights that show the entire body. Costumes today may range from informal rehearsal outfits to elaborate constructions.

Music

Music and dance are usually considered inseparable, though ballets have been performed to experimental sounds and even to silence. The greatest choreographers have been sensitive to music, and many had musical training. They create steps and movements that work in partnership with the music. The creation of a ballet score almost always involves discussion and collaboration between the composer and the choreographer.

During the early history of ballet, music composition went hand in hand with dance composition. But as ballets become independent theatrical forms, music was reduced in importance. Serious composers did not often write dance music. In the late 1800's, the Russian composer Tchaikovsky wrote several beautiful ballet scores that restored the reputation of music composed specifically for ballet. In the 1900's, Igor Stravinsky, another Russian-born composer, continued this tradition by writing 15 ballet scores that greatly influenced the art form.

Many ballets are set to music already composed for concert rather than theatrical performance. The music may provide the inspiration for the ballet. All types of music can be used, including classical, rock, and jazz.

Preserving a ballet

A ballet does not have a firm text, as does a book or the written score of a musical composition. Choreographers often do not document their works. As a result, a ballet's choreography can easily be lost. Even if a choreographer makes no changes in a work, the steps and style may become altered as new dancers learn and perform them. Dancers may change the choreography intentionally or unintentionally. They may forget movements and lose details of the work. Sometimes choreographers change a ballet to keep it fresh. A choreographer may want to try a different approach or make adjustments to accommodate a dancer's strengths and weaknesses.

Throughout ballet history, there have been efforts to develop systems of notation that would preserve the steps and patterns of a dance. Choreographers often develop personal systems of keeping notes. Although much of what we know about earlier dances comes from such systems and notes, they all were incomplete.

In the 1920's, a Hungarian choreographer and teacher named Rudolf von Laban developed a system called *Labanotation* to analyze and record dance movement in great detail. However, Labanotation is complex and requires a specially trained notater, an expense many choreographers cannot afford.

Film, videotape, and television broadcasts have helped preserve ballets, but they are only partly successful. They cannot provide the detail and thoroughness a dancer requires to learn a work. Computer graphics can be a tool for dance analysis and are even being used to create choreography. Other resources that can help preserve ballets include verbal descriptions by choreographers, performers, spectators, and critics; photographs; and musical scores.

History

The birth of ballet. Ballet originated in Italy in the 1400's and 1500's, during a cultural movement called the Renaissance. At that time, Florence and other powerful Italian cities made up nearly independent units called *city-states*. The wealthy families who ruled the city-states did much to promote the arts. The ruling families com-

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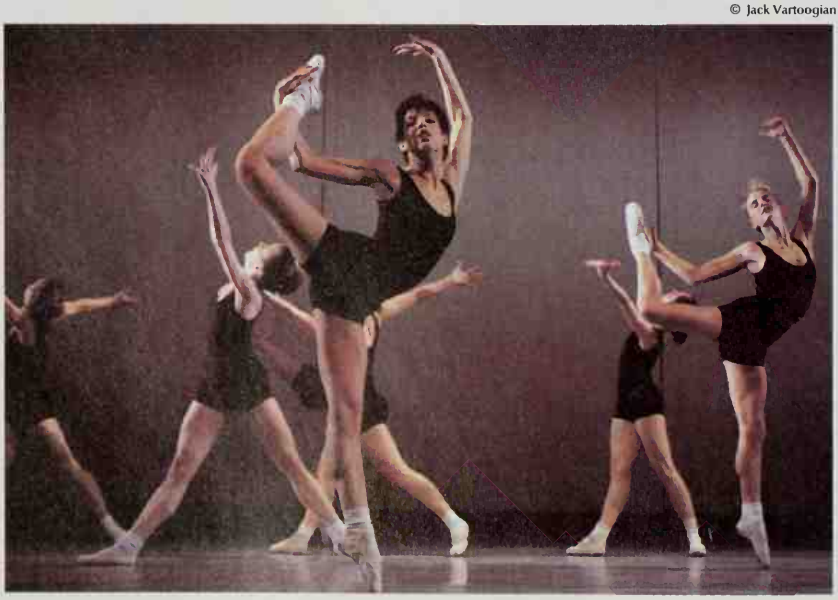

Modern sets and costumes are often simpler than those used in the elaborate productions of classical ballets. The dancers shown at the left wear informal black costumes. They are performing on an empty stage with lighting replacing sets to create a mood.

peted with one another in giving costly, fancy entertainments that included dance performances. The dancers were not professional. They were nobles of the court who danced to please their ruler.

Catherine de Médicis, a member of the ruling family of Florence, became queen of France in 1547. She introduced into the French court the same kind of entertainment she had known in Italy. The dances were staged by Balthasar de Beaujoyeulx, who moved from Italy in 1555 and became Catherine's servant and dancing master.

Many historians consider the first ballet to be Beaujoyeulx's *Ballet Comique de la Reine,* performed in Paris in 1581 in honor of a royal wedding. It was a magnificent spectacle that lasted more than five hours. The ballet included specially composed music, singing, and spoken verse as well as dancing. Because dance technique was limited, Beaujoyeulx relied on lavish costumes and scenery to impress the audience. The ballet was a great success and was widely imitated in other European courts.

Italian dancing masters taught European courtiers how to dance, and they wrote manuals that preserved many steps for modern historians. Choreography was based on the social dances of the 1500's, such as the fast-paced *courante,* the lively *galliard,* and the stately *pavan.*

Because dancing was an activity of the royal court, it emphasized refinement, elegance, and grace. Women wore such long, heavy dresses that their movements were difficult to see. Men's clothes gave them more freedom for fancy footwork and jumps. Performers often wore masks. Many ballets dealt with love and tales from Greek and Roman mythology. In England, court spectacle took the form of *masques.* This entertainment, which reached its peak in the early 1600's, often included music and dancing as well as dialogue by leading writers.

The rise of professional ballet. As ballet developed, it required greater skill. As a result, professional dancers began to replace courtiers, who became the audience rather than the performers.

The *Ballet Comique de la Reine* helped make Paris a center of the ballet world. King Louis XIV, who ruled France from the mid-1600's to his death in 1715, promoted ballet further during his reign. Louis enjoyed dancing both as a spectator and as a participant. In 1661, he founded the Royal Academy of Dancing, and in 1669, the Royal Academy of Music. The music academy, soon known as the Paris Opéra, established a dancing school in 1672. Ballet as a profession can be dated from this period. Through serious training, professional dancers developed skills that had been impossible for amateurs, and dancing became more athletic and lively.

Louis's dancing master was Pierre Beauchamps (or Beauchamp). Beauchamps is credited with defining and naming many of the ballet steps used today, including the five positions of the feet. Most ballet steps have French names because of France's central role in developing the art form.

In the early 1700's, two famous ballerinas in Paris came to represent the two main styles in ballet. Marie Sallé gained fame for her dramatic expressiveness. Her rival, Marie Camargo, was known for her technical brilliance. Camargo shortened her skirts to make her steps more visible.

Professional dancers gradually moved from royal courts to performing for the general public in theaters. Dancers, teachers, and choreographers traveled from country to country. One of the greatest companies formed during this period was the Russian Imperial Ballet of St. Petersburg, now widely known as the Kirov Ballet. Its ballet school was founded in 1738.

Ballet d'action. By the mid-1700's, a number of dance masters had developed the *ballet d'action,* a French phrase meaning *ballet with a story.* This form told a story through dance and pantomime without the aid of spoken words as in earlier ballets.

Jean Georges Noverre was the most famous promoter of ballet d'action. In an influential book called *Letters on Dancing and Ballet* (1760), Noverre wrote that technical skill should not be emphasized for its own sake. Noverre insisted that ballets should combine plot, music, and dancing in a unified whole. He urged ballet dancers to stop using masks, wigs, and bulky costumes to help explain plot and character. Noverre claimed that skillful dancers could express these story elements using only their bodies and faces.

The subject matter of story ballet began to change from its previous emphasis on mythology. Noverre still created ballets based on Greek myths and drama, but other choreographers started to explore different themes. Jean Dauberval, a Noverre pupil, dealt with ordinary people in his comic ballet about young lovers, *La Fille mal gardée (The Ill-Guarded Girl).* It was first produced in 1789 and is one of the oldest ballets still performed today. In Italy, Salvatore Viganò drew on historical characters, such as Joan of Arc and Richard the Lion-Hearted, for some of his works.

Romantic ballet. In the early 1800's, the romantic period developed in ballet. The stories in romantic ballet emphasized escape from the real world into distant lands or into a dreamlike world of the supernatural. During this period, ballet technique expanded, especially for women, who began to dance on their toes. The development of point dancing during the romantic period was a direct result of the increased fascination with dreams and enchantment. Elevation on the toes suggested a lifting away from an earthly state into a supernatural world. Carlo Blasis of Italy became perhaps the most important ballet teacher of the 1800's. His writings further defined and expanded ballet techniques, influencing later generations of dancers.

In Paris, the Italian choreographer Filippo Taglioni created the first romantic ballet, *La Sylphide* (1832), for his daughter, Marie. She danced the role of the *sylphide,* a fairylike being, in a costume that set a new fashion for ballerinas. It included a light, white skirt that ended halfway between the knee and ankle. Her arms, neck, and shoulders were bare. Marie Taglioni, with her dreamlike style, became the greatest star of Paris ballet. Her chief rival was the Austrian ballerina Fanny Elssler, who also danced in Paris. Elssler's style expressed strong human feelings. She became famous for her lively character dances, particularly the *cachucha,* a Spanish dance performed with castanets. Elssler's *cachucha* caused a sensation when she first danced it in 1836.

The outstanding ballet of the romantic period was *Giselle* (1841), choreographed by Jean Coralli and Jules Perrot. The ballet tells the story of a peasant girl who falls in love with a nobleman in disguise. She goes in-

Engraving (1582) by an unknown artist; Bibliothèque Nationale, Paris

Ballet Comique de la Reine, an influential early ballet, was performed in Paris in 1581. King Henry III of France and his court watched the spectacle in a decorated palace hall, *above.*

sane and dies after discovering that he is already engaged and has betrayed her. The part of Giselle requires both expressive and technical skill and remains one of the most challenging roles in a ballerina's repertory.

Paris was the capital of the ballet world throughout the romantic period, which lasted through the mid-1800's. However, many dancers and choreographers who trained and worked in Paris took their techniques to cities outside France. For example, August Bournonville, a Danish dancer and choreographer, worked in Paris before taking over the Royal Danish Ballet in 1830. He developed a light, open, buoyant style that remains popular in Denmark today.

Ballet in Russia. During the 1800's, a number of choreographers and dancers settled in Russia. Perhaps the most important was the French choreographer Marius Petipa. He moved to Russia in 1847 and served as the ballet master for the Russian Imperial Ballet of St. Petersburg from 1870 to 1903. Petipa helped make St. Petersburg the world center of ballet by the late 1800's. He specialized in creating spectacular choreography for women, notably the leading role in *The Sleeping Beauty* (1890) and the first and third acts of *Swan Lake* (1895).

The St. Petersburg company produced some of the greatest dancers in ballet history. The best known include Anna Pavlova and Vaslav Nijinsky. Pavlova became famous for the graceful, poetic, spiritual quality of her dancing. Nijinsky elevated the status of male dancers and thrilled audiences with his spectacular leaps.

Both Pavlova and Nijinsky later danced with a famous Russian touring company, Sergei Diaghilev's Ballets Russes. Diaghilev, one of the world's greatest producers of ballets, established the company in Russia in 1909. Diaghilev was interested in new developments in ballet and attracted some of the most important modern artists and composers of his time to collaborate on ballets. His choreographers included George Balanchine, Michel Fokine, Léonide Massine, Nijinsky, and Nijinsky's sister Bronislava Nijinska.

With Diaghilev's company, Fokine had the opportunity to carry out his ideas. In many ballets of the time, story-telling scenes alternated with pantomime and displays of technical dancing. Fokine wanted all the elements in a ballet to contribute to the story. He urged that all the arts in ballet be blended into a harmonious whole.

For the Ballets Russes, Fokine created such brilliant works as *Scheherazade* (1910), *The Firebird* (1910), and *Petrouchka* (1911). He also created one of the first one-act ballets without a story, *Chopiniana* (1907), renamed *Les Sylphides* (1909), to music by Polish composer Frédéric Chopin. Nijinsky also choreographed major experimental works for the Ballets Russes, especially *Afternoon of a Faun* (1912) and *The Rite of Spring* (1913). Both works caused a sensation at their premieres in Paris.

The Ballets Russes never actually performed in Russia. However, the company brought a Russian spirit and artistry to dance that thrilled audiences throughout the world. In Europe, its huge popularity revitalized ballet. The company also kindled enthusiasm about ballet in areas that had no strong tradition of ballet, such as South America. The Ballets Russes broke up after Diaghilev's death in 1929. His dancers and choreographers joined companies in many parts of the world, and they influenced ballet wherever they went.

Engraving (1781) by John Boydell; Courtesy of the Dance Collection, New York Public Library at Lincoln Center, Astor, Lenox and Tilden Foundations

The ballet d'action developed in the mid-1700's. These ballets told stories through dance and pantomime, omitting the spoken words of earlier ballets. Jean Georges Noverre became the leader of the form with such works as *Jason and Medea* (1763).

Russia became part of the Soviet Union in 1922, and the Soviet Union maintained a strong reputation for training dancers for much of the 1900's. From the late 1940's to the early 1990's, the Soviet Union and its Communist allies competed with the non-Communist nations of the West for power and international influence. During this period of rivalry, known as the *Cold War,* the two leading Soviet ballet companies, the Kirov and the Bolshoi, had some of the world's most technically accomplished dancers. They occasionally toured outside the Soviet Union, dazzling Western audiences with their skill. The leading Soviet dancers included Rudolf Nureyev, Maya Plisetskaya, and Galina Ulanova.

In 1961, Nureyev defected to the West while the Kirov was performing in Paris. Ballerina Natalia Makarova defected from the Kirov in 1970, and Mikhail Baryshnikov in 1974. All three refugees became important forces in Western ballet, dancing as guest artists and staging works from the Russian repertory. Nureyev and Baryshnikov eventually became artistic directors of major companies—Nureyev with the Paris Opéra Ballet and Baryshnikov with the American Ballet Theatre.

The Soviet Union broke apart in 1991, and economic difficulties undermined the health of ballet in Russia. These difficult conditions led many performers to leave their country and pursue careers in the West.

Ballet in England. Two major ballet companies were founded in England in the early 1900's. One was the Ballet Rambert, now called the Rambert Dance Company, originated by the Polish teacher Marie Rambert. The other was the Vic-Wells Ballet, directed by Dame Ninette de Valois. The company later became the Sadler's Wells Ballet and is now called the Royal Ballet. Sir Frederick Ashton, who worked with this company, became England's leading choreographer. He created ballets with no story (*Symphonic Variations,* 1946), dramatic works (*A Month in the Country,* 1976), and playful ballets (*Tales of Beatrix Potter,* 1971). Ashton choreographed many ballets for the great English ballerina Dame Margot Fonteyn. Together they created a British ballet style known for its dignity and sensitivity to musical phrasing. Other leading dancers who worked under Ashton included Antoinette Sibley and Anthony Dowell, who formed a famous partnership. Dowell became director of the Royal Ballet in 1984. The Birmingham Royal Ballet, descended from the Royal Ballet's touring company, became a major company in its own right.

Ballet in the United States. After Diaghilev's death, George Balanchine worked briefly in Europe and then settled in the United States in 1933. There, he helped found the School of American Ballet and a troupe that became the New York City Ballet. Balanchine was one of the most important choreographers of the 1900's, creating a wide variety of traditional and experimental works. He became famous for ballets that centered on movement for movement's sake. He created ballets that were physical representations of the music and ballets that evoked a mood without trying to tell a story.

Balanchine was an important teacher, and he expanded the ballet vocabulary and point technique. Many of the finest ballerinas of the 1900's danced in his company, including Melissa Hayden, Maria Tallchief, Violette Verdy, and Suzanne Farrell. Notable male dancers under Balanchine included Jacques d'Amboise, Arthur Mitch-

Detail of a lithograph (about 1831) of Marie Taglioni in *Flore et Zéphire* after a painting by Chalon and R. J. Lane; New York Public Library at Lincoln Center

Marie Taglioni was one of the the most influential dancers of the romantic movement. She introduced a costume that included a light, white skirt that ended between the knee and ankle.

Courtesy of the Dance Collection, New York Public Library at Lincoln Center, Astor, Lenox and Tilden Foundations

Vaslav Nijinsky and Anna Pavlova were famous stars of Russian ballet during the early 1900's. He played a slave and she played the heroine, Armide, in *Le Pavillon d'Armide* (1907).

ell, Edward Villella, and Peter Martins. Most of his leading dancers became choreographers, teachers, and company directors throughout the world.

In 1940, a troupe that became the American Ballet Theatre (ABT) gave its first performance. The ABT joined the New York City Ballet as one of America's two major ballet companies. The ABT developed a repertory that included works by choreographers Agnes de Mille, Jerome Robbins, and Antony Tudor. The three explored various types of dramatic expression. De Mille's *Rodeo* (1942) is set in the Western United States and includes cowboy characters. Robbins's *Fancy Free* (1944) is a lighthearted work that follows three sailors on leave as they look for fun in New York City. Tudor's *Pillar of Fire* (1942) explores the psychological conflicts of a shy woman who fears that she will never marry.

In the mid-1900's, several ballet companies were established in New York City. The Joffrey Ballet (now the Joffrey Ballet of Chicago) was founded by choreographer Robert Joffrey in 1956. It was the first American troupe to invite a new generation of experimental choreographers to compose dances. Among the most notable were Laura Dean and Twyla Tharp. The Joffrey also encouraged important revivals and was among the first to perform ballets choreographed to rock music, such as Gerald Arpino's *Trinity* (1970).

In 1968, the African American dancer Arthur Mitchell established a dance school in the Harlem district of New York City. The school led to the founding of the Dance Theatre of Harlem. Mitchell dedicated his company to challenging the prejudice that black dancers were not suited to ballet. The Dance Theatre of Harlem presented a varied repertory, including works by black choreographers. The efforts of Mitchell and others encouraged many ballet troupes to become multiracial.

Ballet in Canada. Canada, like the United States, benefited from the arrival of European dancers, teachers, and choreographers during the mid-1900's. The National Ballet of Canada, founded in 1951, was first directed by the British dancer Celia Franca. The company gained even greater recognition under the directorship of the Danish dancer Erik Bruhn during the 1980's. The Latvian-born dancer Ludmilla Chiriaeff founded Les Grands Ballets Canadiens in 1958. Among its leading choreographers was Brian Macdonald. He also worked for the Royal Winnipeg Ballet, Canada's oldest major ballet company, founded in 1939.

Ballet in Europe. European ballet companies fared better financially than many North American companies in the late 1900's. Many benefited from government assistance. European dance groups welcomed talent from other countries. John Cranko, a South African who worked in England, and John Neumeier of the United States served as resident choreographers with German companies, beginning in the 1960's. Cranko raised the Stuttgart Ballet to world importance, and Neumeier brought international recognition to the Hamburg Ballet. Both created works with a strong literary and dramatic base. The French-born choreographer Maurice Béjart developed an athletic style for his troupe, Ballet of the 20th Century, based in Belgium and Switzerland. Jiří Kylián of the Czech Republic created a broad range of works as director of the Netherlands Dance Theatre.

The American Glen Tetley brought his modern style to companies in the Netherlands and Germany. Another American, Mark Morris, worked for several years in Belgium as resident choreographer of the Théâtre Royal de la Monnaie in Brussels. In France, the Paris Opéra Ballet was the focus of international attention in the 1980's, when Rudolf Nureyev became ballet director. Ballet in Denmark showed stability and artistic consistency throughout most of the 1900's. The Royal Danish Ballet, based in Copenhagen, preserved historical tradition with its dedication to the Bournonville style.

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Ballet in musical comedies has been popular since the early 1900's. A number of leading ballet choreographers have created dances for Broadway musicals. In 1943, Agnes de Mille choreographed the dances for the famous musical *Oklahoma!*, including the extended dream ballet shown at the left.

© Tom Brazil

Mikhail Baryshnikov, *right,* ranks among the world's leading ballet dancers. He helped found the White Oak Dance Project, a touring company, and became its featured performer.

Recent developments. During the late 1900's, many ballet companies were founded throughout the world. In the United States, important companies established in Houston, Miami, and other cities joined older companies, such as the San Francisco Ballet, in raising the level of dancing throughout the country. After returning to the United States from Belgium, Mark Morris became choreographer for the White Oak Dance Project, a touring company he helped found with Mikhail Baryshnikov in 1990. Such companies provided more opportunities for dancers and choreographers and helped educate audiences.

However, in spite of growing interest in ballet, U.S. companies struggled to survive in difficult economic times. They faced limited funding from local and federal government sources and from private support.

Critically reviewed by Katy Matheson

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Biographies

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Diaghilev, Sergei
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Ballets Russes
Bolshoi Ballet
Dance
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Russia (picture: Russian ballet troupes)

Outline

I. Training for ballet
A. The ballet teacher
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D. Point work
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III. Kinds of ballet
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Questions

When does a dancer perform a *révérence?*
What was the significance of the *Ballet Comique de la Reine?*
What is the purpose of the *barre?*
How did Jean Georges Noverre influence ballet?
What is *Labanotation?*
Which dancer founded the Dance Theatre of Harlem?
What is the responsibility of the choreographer?
Who composed the first romantic ballet?
What is a *divertissement?* A *pas de deux?*
Who was Sir Frederick Ashton?

Additional resources

Level I

Barber, David W. *Tutus, Tights and Tiptoes: Ballet History as It Ought to Be Taught.* Sound & Vision, 2000.
Bussell, Darcey. *Ballet.* Dorling Kindersley, 2000.
Newman, Barbara. *The Illustrated Book of Ballet Stories.* D K Pub., 1997.

Level II

Barringer, Janice, and Schlesinger, Sarah. *The Pointe Book: Shoes, Training & Technique.* Rev. ed, Princeton Bk. Co., 1998.
Bremser, Martha, and Nicholas, Larraine, eds. *International Dictionary of Ballet.* 2 vols. St. James Pr., 1993.
Greskovic, Robert. *Ballet 101.* Hyperion, 1998.

Ballets Russes, *ba LAY ROOS,* was the most important ballet company of the early 1900's. It was founded and directed by Russian ballet director and producer Sergei Diaghilev.

Diaghilev established the Ballets Russes in 1909. At first, he used dancers and *choreographers* (dance composers) from the Russian imperial theaters. Diaghilev soon persuaded some of the most innovative artists and composers of his time to collaborate on his ballets. They included dancers Tamara Karsavina, Vaslav Nijinsky, and Anna Pavlova and composers Claude Debussy, Sergei Prokofiev, Maurice Ravel, Darius Milhaud, Erik Satie, and Igor Stravinsky. The chief choreographers were Michel Fokine, Nijinsky, his sister Bronislava Nijinska, Léonide Massine, and George Balanchine. Designers included such noted artists as Léon Bakst, Henri Matisse, Georges Rouault, Juan Gris, Marie Laurencin, Georges Braque, and Pablo Picasso.

The company staged about 70 ballets during its 20-year history. Among the most significant ballets were *Les Sylphides* (1909), *The Firebird* (1910), *Petrouchka* (1911), *Afternoon of a Faun* (1912), *The Rite of Spring* (1913), *Parade* (1917), and *Apollo* (1928). The Ballets Russes disbanded after Diaghilev's death in 1929.

The Ballets Russes revitalized ballet in Europe. It also kindled enthusiasm about ballet in areas that had no strong tradition of ballet, such as South America. After the company broke up, many of its members joined

companies in other parts of the world, and they further influenced ballet. In 1932, members of the Ballets Russes helped form the Ballets Russes de Monte Carlo.

Ballistic missile. See **Guided missile** (Ballistic missiles).

Ballistic Missile Early Warning System. See **Radar** (In the military; map).

Ballistics, *buh LIHS tihks,* is a branch of engineering that deals with the motion and behavior of projectiles, such as bullets, rockets, bombs, and guided missiles. Research in ballistics is conducted by all branches of the United States armed forces. The United States Army carries on its primary ballistics research at the Aberdeen (Maryland) Proving Ground. The U.S. Navy conducts its main ballistics research at the Naval Surface Weapons Center in Dahlgren, Virginia.

Ballistics is divided into three main branches: *interior, exterior,* and *terminal* ballistics. Police use a science called *forensic* ballistics.

Interior ballistics deals with the motion of a projectile as it travels down the barrel of a weapon, such as a rifle, tank gun, or rocket launcher. Interior ballistics experts study the forces that affect the projectile, including its weight and speed. They also study how the projectile interacts with the barrel of the weapon.

The speed with which a projectile leaves a gun barrel or a launcher is called the *initial velocity* or *muzzle velocity.* With modern propulsion techniques, the projectile's initial velocity may be as high as 4,000 feet (1,200 meters) per second for some rifles and 5,000 feet (1,500 meters) per second for some large guns. Ideally, the projectile should leave the gun barrel with a high initial velocity and without disturbances to the direction of its motion.

Exterior ballistics deals with the behavior of a projectile from the time it leaves the weapon until it ends its flight. Determining the projectile's *trajectory* (path) is the main problem in exterior ballistics. To determine the trajectory, an exterior ballistics expert must know the interior ballistics data, such as the initial velocity of the projectile, and the effects of gravity and air on the projectile.

The force of gravity makes the projectile fall toward the earth while in flight. The effects of air on the projectile are more difficult to predict. The amount of air resistance to a projectile depends on the projectile's size, shape, and speed, and on the density of the air. Air resistance slows the projectile and reduces its *range* (distance it travels). Winds can shorten or lengthen the range. Cross winds may force the projectile to one side or another. A projectile from a rifled gun spins and behaves like a gyroscope. Air pressure on the spinning projectile causes *gyroscopic precession.* This effect makes it drift slowly along a spiral path, turning in the direction of its spinning motion.

Determining trajectories involves some of the most complex problems of mathematics and physics. However, the use of supercomputers in exterior ballistics can provide solutions that are highly accurate.

Terminal ballistics is the study of the effect a projectile has on a target and the surrounding area. Since targets can be in almost any form, the study of terminal ballistics includes many areas of structural mechanics and materials science. Recent advances in *radiography* (using X rays) and high-speed photography have increased knowledge in terminal ballistics.

Damage to a target can be produced by fragmentation, impact, blast, heat, fire, radiation, and chemical or bacteriological action. A projectile's ability to damage a target depends on such conditions as the size, weight, speed, and composition of the projectile and the composition of the target.

Forensic ballistics is a special field that helps police identify bullets fired from guns. Every gun leaves certain marks on the bullets it fires. These marks differ from those made by any other gun. As a result of this fact, ballistics experts can examine these marks and determine whether a particular bullet was fired from a particular gun. Judith K. Temperley

Harold E. Edgerton, Massachusetts Institute of Technology

Terminal ballistics uses high-speed photography to study the effects that bullets and other projectiles have on targets. The picture at the left shows how a .30-caliber bullet rips and scorches a playing card as it travels through it.

Jim Shepherd

A hot-air balloon rally is a colorful spectacle. Many sport balloonists in the United States participate in rallies like this one. Most rallies include races and other contests.

Balloon

Balloon is a bag filled with heated air or a light gas so that it rises and floats in the air. A balloon rises because the heated air or gas inside is lighter and less dense than the surrounding air.

Balloons are made in many sizes, shapes, and designs and have many uses. Children play with toy balloons. Scientists use balloons to carry instruments that gather information about the weather. Balloons equipped with transmitters are used to relay radio and television programs to remote areas. Some balloons have a basket attached beneath the bag to carry a pilot and passengers. Such large, piloted balloons are used by people who enjoy the thrill of sport ballooning. Piloted balloons are also used for scientific research.

Balloons may be *captive, free-floating,* or *powered.* A captive balloon is anchored to the ground by a cable. A free-floating balloon travels in whatever direction the wind blows. A pilot can control the vertical movement of a piloted, free-floating balloon but cannot steer it. However, the pilot can control the course of a balloon flight to some degree by rising or descending to find a wind blowing in the desired direction. A powered balloon is called an *airship.* An airship has an engine and propellers to power it, along with rudders and instruments that enable a pilot to steer it. This article discusses captive and free-floating balloons—the kinds of balloons that cannot be steered. For information on airships, see the article **Airship.**

Kinds of balloons

There are two chief kinds of balloons: (1) hot-air balloons and (2) gas balloons. Hot-air balloons are used mainly for sport ballooning. Gas balloons are used for sport ballooning, scientific research, and a variety of other purposes.

Hot-air balloons rise because the air inside the bag is warmer—and therefore lighter—than the surrounding air. Air expands when heated, which makes it lighter than an equal volume of cool air. The heat for a hot-air balloon comes from a burner that uses *propane,* a safe and inexpensive gas. The burner produces a flame that reaches up into the bag.

The bag of a hot-air balloon is made of nylon or polyester. The size of the bag depends on the weight of the *payload* that the bag has to lift. The payload consists of the basket, passengers, equipment, and supplies. The heavier the payload is, the larger the bag must be. The size of the balloon is normally expressed in terms of the volume of the bag when fully inflated. To carry two passengers, the bag must have a volume of about 60,000 cubic feet (1,700 cubic meters).

Older balloons have a circular *rip panel* at the top. A rip panel is controlled by a cord and is torn open to deflate the bag for landing. Near the rip panel is a vertical slit called the *cooling vent,* which is also operated by a cord and used if the pilot wants to make a quick descent. Most new balloons combine the vent and the rip panel in a *parachute top,* which looks like a parachute plugging an opening at the top of the bag. The bottom of the bag has a large opening, called the *mouth,* through which the heated air rises into the bag.

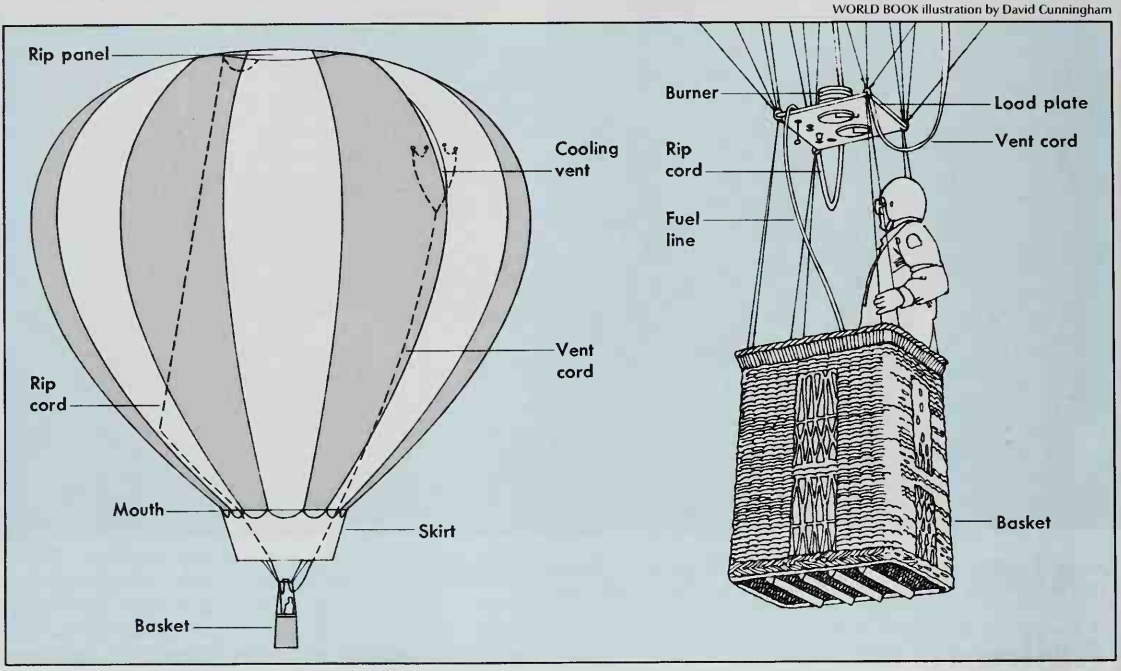
The payload on a hot-air balloon hangs from strong tapes sewn into the bag. The basket is made of wicker

Patrick J. Cannon, the contributor of this article, is President of EarthRise Tethered Balloon Systems and Engineering.

How a hot-air balloon works

After a hot-air balloon is inflated, the pilot feeds fuel to the burner and lifts off. To rise higher, the pilot burns more fuel. To lose altitude, the pilot either burns less fuel or opens the cooling vent to let out air. Upon landing, the pilot pulls open the rip panel to deflate the bag.

WORLD BOOK illustration by David Cunningham



or aluminum. The burner is fixed to a metal platform above the basket and directly below the bag's mouth. Propane tanks are carried in the basket. A fuel hose leads from each tank to the burner.

Gas balloons may be inflated with hydrogen, helium, or natural gas. Hydrogen is the lightest of all gases and so has the greatest lifting power. But hydrogen must be handled with care because it is highly combustible. Although helium is slightly heavier than hydrogen, it is much safer. Natural gas produces less lift than either hydrogen or helium but costs far less.

The most important kinds of gas balloons include (1) sport balloons, (2) expandable balloons, (3) superpressure balloons, and (4) zero-pressure balloons. The last three kinds are used for scientific purposes. They carry instruments that record atmospheric data up to altitudes of 30 miles (48 kilometers).

Sport balloons. The bag of a gas sport balloon may be made of plastic or rubberized cotton. A popular gas sport balloon for two people has a volume of about 35,000 cubic feet (1,000 cubic meters). A balloon of this size has a diameter of about 40 feet (12 meters).

The bag is inflated through an open tube at the bottom. This tube, called the *appendix,* remains open during the flight. As the balloon rises, the air pressure around the balloon decreases, which causes the gas in the bag to expand. The excess gas escapes automatically through the appendix. At the top of the bag is another opening, which is covered by a valve. The valve is controlled by a rope that hangs down through the bag and out the appendix to the basket. To make the balloon descend, the pilot pulls on the rope, which opens the valve and lets out a tiny bit of gas at a time.

Some sport balloons have a cotton net with wide *meshes* (open spaces) covering the bag. If the bag should tear in flight, it would fold up inside the net and form a crude parachute. The net is attached below the bag to a large wooden or metal structure called the *load ring.* The basket in which people ride hangs from the load ring. Some new sport balloons have no net.

Expandable balloons consist of a closed rubber bag. The typical expandable balloon measures about 5 feet (1.5 meters) in diameter at take-off. As the balloon rises and the gas expands, however, the bag may stretch to about 20 feet (6 meters). When the balloon reaches a certain height, the expanding gas bursts the bag. A parachute attached to the bag's payload of instruments then opens and carries them to the ground.

Superpressure balloons are so named because the pressure of the gas inside the bag is slightly higher than that of the surrounding air. A superpressure balloon is made of low-stretch material, such as polyester or polyaramid. At the time of launching, the bag is partly inflated and then sealed off. As the balloon rises, the gas expands and fills the bag. The volume of the displaced air stays constant, and the balloon rises only to the altitude where the air has the same density.

Superpressure balloons are made in many sizes. The size determines the altitude at which the balloon will float. The larger the balloon, the higher it will rise. The largest balloons have a volume of more than 3 million cubic feet (85,000 cubic meters).

A superpressure balloon can remain aloft for many months as it circles the earth. Operators on the ground

or in aircraft control the balloon's equipment by radio. To make the balloon descend, the operators issue an electronic command that causes the bag to deflate.

Zero-pressure balloons. The pressure of the gas at the bottom of a zero-pressure balloon is the same as that of the surrounding air. The bag is made of polyethylene. It is inflated through an opening called a *duct.* The bag is partly inflated at take-off. It fills out as the balloon reaches higher altitudes and the gas expands. Excess gas escapes through the duct. From time to time, the balloon must release *ballast* (weight) to remain aloft. The ballast consists of *steel grit,* which is a finely powdered form of steel. Operators on the ground release the ballast by radio signals. When the ballast is gone, the balloon descends. The flight of a zero-pressure balloon generally lasts only a few days.

Zero-pressure balloons were once used to carry scientific researchers who conducted investigations of the upper atmosphere. The researchers either wore pressure suits or rode in airtight, pressurized cabins because the air pressure in the upper atmosphere is extremely low. A pressure suit provides pressure on the body so that normal breathing and blood circulation can continue. Inside a pressurized cabin, the air is maintained at near sea level pressure and composition.

Zero-pressure balloons are made in many sizes. Some of the largest bags have a volume of more than 50 million cubic feet (1.4 million cubic meters).

How balloons are used

Scientific uses. Expandable balloons are widely used by *meteorologists* (scientists who study the weather). These balloons often carry a device called a *radiosonde.* A radiosonde has instruments that measure the temperature, humidity, and pressure of the air at various altitudes. It also includes a radio, which sends the readings to stations on the ground. Meteorologists use this information in forecasting the weather.

Superpressure and zero-pressure balloons are used in a variety of scientific programs. Some of these balloons carry instruments that record data on atmospheric conditions. For example, they have been used to measure radiation and to study wind movements. They have also been used to collect small meteorites and to study stars and planets. Information obtained by superpressure and zero-pressure balloons has aided scientists in developing space programs.

Recreational uses. Gas and hot-air balloons are both used for sport ballooning. Many balloonists participate in races and rallies. Others simply like to drift peacefully over the countryside.

World championships for hot-air balloons and gas balloons are held in alternate years in various countries. In the United States, almost all sport balloonists use hot-air balloons. The United States National Hot-Air Balloon Championships, established in 1963, are held annually.

United States balloon pilots must be licensed by the Federal Aviation Administration (FAA). A person must be at least 14 years old to fly alone with a student pilot's license. To obtain a private pilot's license and carry passengers, a person must be at least 16 years old, have at least 10 hours of flight experience with a qualified instructor, and pass a practical and written examination.

Most sport balloon flights take place early in the morning or late in the afternoon when the wind is usually less strong. Sport balloons are simple to operate, but a pilot must pay attention to weather conditions.

Operating a hot-air balloon. To inflate a hot-air bal-

© David R. Frazier Photolibrary

National Center for Atmospheric Research

National Center for Atmospheric Research

The three main kinds of scientific balloons are the expandable balloon, *left,* the superpressure balloon, *center,* and the zero-pressure balloon, *right.* These balloons are used to carry instruments that record data about the earth's atmosphere. They can rise up to 30 miles (48 kilometers).

loon, the pilot spreads out the bag on the ground so that the top of the bag lies downwind from the basket. The pilot then lays the basket down sideways facing the bag and attaches the basket to the bottom of the bag. A large fan blows air into the mouth of the bag. When the bag is about half inflated, the pilot starts the burner. As the air heats, the bag gradually rises, pulls the basket upright, and stands up over the burner and the basket.

To lift off, the pilot keeps feeding fuel to the burner. A hot-air balloon does not carry ballast. To ascend higher, the pilot burns more fuel. To lose altitude, the pilot burns less fuel. The cooling vent is used only if a pilot wants to descend rapidly. Upon landing, the pilot opens the rip panel to deflate the bag.

Operating a gas balloon. To prepare for inflation of a gas balloon, the pilot spreads the bag out on the ground so that the top of the bag is centered over the bottom and the rest of the fabric is laid out evenly. The pilot then places the net over the bag, installs the valve at the top of the bag, and begins inflating the bag. As the bag fills, sandbags are hooked in the net to hold the balloon in place. The sandbags will serve as ballast to regulate the balloon's ascent. The sandbags are moved down mesh by mesh to let the balloon up slowly. The pilot then attaches the load ring and the basket and hangs the sandbags along the sides of the basket. Some new sport balloons have no net and are inflated quickly, much as hot-air balloons are.

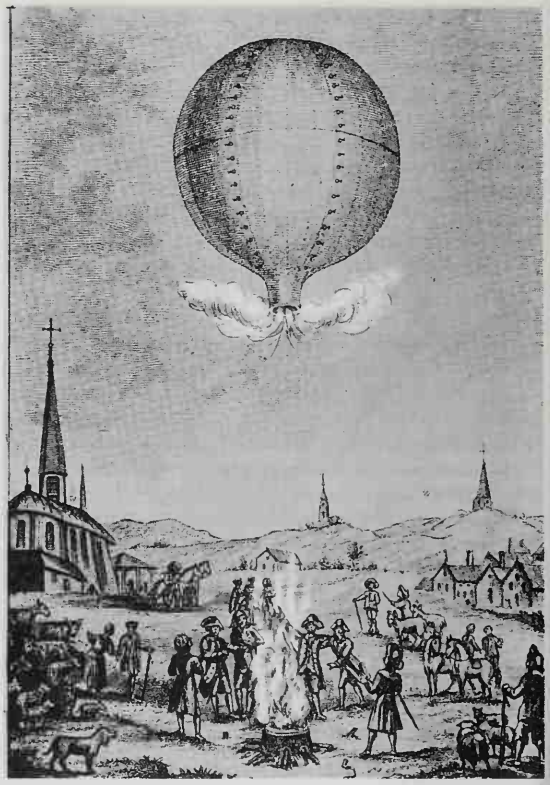
To lift off, the pilot removes a few sandbags until the balloon is just light enough to rise smoothly and still clear any obstacles downwind. Once aloft, the pilot drops small amounts of sand to ascend higher. To lose altitude, the pilot opens the valve at the top of the bag and lets out some gas.

Most gas balloons carry a heavy *drag rope,* which is thrown out just before landing to lighten the load and cushion the fall. A person on the ground can also grab the rope to get control of the balloon. As the basket touches ground, the pilot opens the rip panel to deflate the bag so the wind will not drag the basket.

Other uses. Captive balloons, which are anchored to the ground, have a number of uses in business and industry. Some businesses use captive balloons in outdoor displays. These balloons are often shaped like whimsical human or animal characters. Captive balloons are sometimes used to relay radio and television programs to remote areas. These balloons are sausage-shaped and have a fin assembly on one end, which helps hold them steady in the wind. Operators at ground control stations monitor the broadcasting equipment, as well as the altitude and internal pressure of the balloons.

History

In the late 1700's, two French papermakers, the brothers Jacques Étienne and Joseph Michel Montgolfier, began experimenting with hot-air balloons. The Montgolfiers started their experiments by filling small paper bags with smoke. They at first thought the smoke made the bags ascend. But they later learned the hot air caused the bags to rise. On June 4, 1783, the brothers sent up a large smoke-filled balloon at a public gathering in Annonay, France. The balloon was made of cloth lined with paper and measured 35 feet (11 meters) in diameter.



United States National Museum

One of the first hot-air balloons was made by the Montgolfier brothers and launched in Annonay, France, in 1783.

Three months later, they launched a balloon that carried a duck, a rooster, and a sheep. The flight lasted about eight minutes, and the animals landed safely.

On Oct. 15, 1783, a French scientist named Jean François Pilâtre de Rozier became the first person to make a balloon ascent. He rose about 80 feet (24 meters) in a captive Montgolfier balloon. Pilâtre de Rozier and an army officer, the Marquis François-Laurent d'Arlandes, made the first free flight in a Montgolfier balloon on Nov. 21, 1783. They rose at least 300 feet (90 meters) and stayed up about 25 minutes, drifting over Paris.

The hydrogen balloon. While the Montgolfiers were experimenting with hot-air balloons, a French chemist named Jacques Alexandre Charles was working on hydrogen balloons. Charles was assisted by two craftsmen, the brothers Anne-Jean and Marie-Noel Robert. Charles and the Robert brothers launched the first hydrogen balloon in Paris on Aug. 27, 1783. The balloon, which carried no passengers, was made of rubberized silk. It rose about 3,000 feet (900 meters) and landed in a field about 15 miles (25 kilometers) from the city. See **Gas** (Charles's law).

Charles and Marie-Noel Robert made the first flight in a hydrogen balloon on Dec. 1, 1783. They took off in Paris, rose about 2,000 feet (600 meters), and drifted more than 25 miles (40 kilometers) from the city. As the men landed, Robert stepped out of the basket. The balloon, relieved of his weight, quickly rose more than 9,000 feet (2,700 meters). Charles learned that the air at

that altitude is thin and cold. He landed safely but never flew again. The basic design of his hydrogen balloon is still used in the traditional sport balloon.

The growth of ballooning. Ballooning soon became a fad in Europe, especially in France. Balloon ascents drew many spectators, and balloonists became local heroes. Most of the ascents were made in gas balloons.

On Jan. 7, 1785, Jean-Pierre Blanchard, a French balloonist, and an American doctor named John Jeffries made the first balloon flight across the English Channel. They took off from Dover, England, and landed near Calais, France, two hours later. In 1793, Blanchard also made the first balloon voyage in the United States. The balloon ascent took place in Philadelphia before a large crowd that included President George Washington. Blanchard landed in Gloucester County, New Jersey. His wife, Madeleine-Sophie, also was a famous balloonist.

André Garnerin, a French balloonist, made the first parachute jump from a balloon. He jumped over Paris in 1797. John Wise, an American balloonist, introduced the balloon rip panel in 1839. In 1859, he set a world record by flying in a balloon 1,150 miles (1,850 kilometers) from St. Louis, Missouri, to Henderson, New York.

Balloons in war. Balloons were first used in warfare by France in 1794. France was then at war with several other European countries. The French used captive balloons as observation platforms to learn the locations of enemy troops and direct the movements of French troops. See **Aircraft, Military** (picture).

During the American Civil War (1861-1865), a balloonist named Thaddeus Lowe organized and directed a balloon corps in the Union Army. The North used captive observation balloons to direct artillery fire and to report Confederate troop movements.

Balloons had another use during the Franco-Prussian War (1870-1871), when German armies surrounded Paris. The people of Paris communicated with the outside world by means of balloons and carrier pigeons. They launched more than 60 balloons, which carried a total of nearly 10 short tons (9 metric tons) of mail.

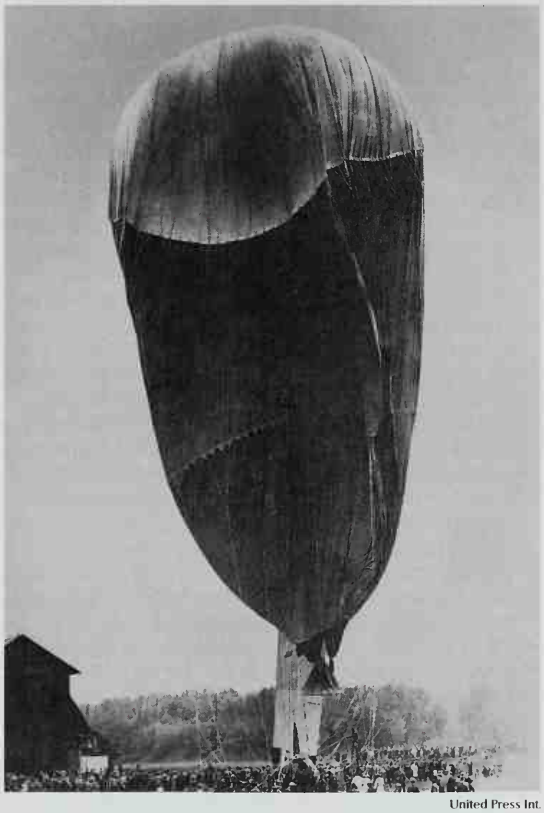
During World War I (1914-1918), captive observation balloons were widely used both by the Allies, which included France, Britain, and Italy, and by the Central Powers, which included Germany and Austria-Hungary. Britain also introduced *balloon barrages* during the war for protection against low-flying enemy airplanes. The barrages consisted of captive balloons from which steel cables were suspended. Enemy planes had to fly above the balloons or risk being ripped apart by the cables. The British set up a barrage 51 miles (82 kilometers) long around London. Italy, France, and Germany also used balloon barrages.

During World War II (1939-1945), balloon barrages were again used by Britain and other Allied nations and by Germany and other Axis countries. The barrages were used on land and on ships. The Japanese used balloons to carry bombs. They released more than 9,000 bomb-carrying balloons that were intended to land on the West Coast of the United States. Only a few hundred reached the United States, and the damage was minor.

Balloon explorations of the upper atmosphere reached new heights in the early 1930's. Auguste Piccard, a Swiss physicist, invented an airtight cabin, which he attached to a huge hydrogen balloon. In 1931, he and an assistant, Paul Kipfer, ascended in the balloon from Augsburg, Germany. They rose 51,775 feet (15,781 meters) into the *stratosphere,* the atmospheric layer above nearly all clouds. In 1932, Piccard and another assistant, Max Cosyns, made an ascent near Zurich, Switzerland, and rose 53,152 feet (16,201 meters). The purpose of both flights was to study *cosmic rays,* high

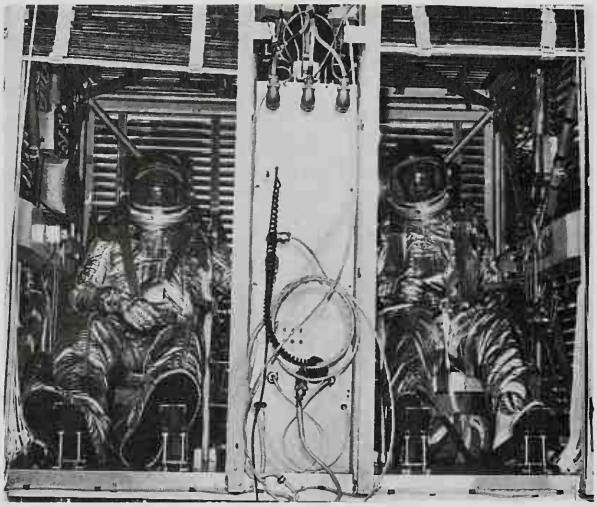
Photoworld

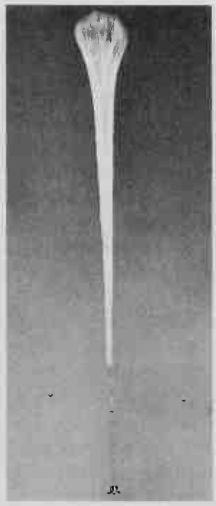
Balloon barrages were used by the British during World War II. They helped prevent attacks by low-flying enemy planes.



United Press Int.

The first ascent into the stratosphere was made by Auguste Piccard in 1931 in a cabin attached to this gas balloon.





Wide World

The highest human balloon ascent was made in 1961 by U.S. Navy officers Victor A. Prather, Jr., *far left,* and Malcolm Ross. A zero-pressure balloon lifted them 113,739.9 feet (34,668 meters).

energy particles that originate in outer space.

Jean Piccard, Auguste's twin brother, also made balloon ascents to study cosmic rays. In 1934, Jean and his wife, Jeannette, who served as pilot, rose to a height of 57,579 feet (17,550 meters). In 1960, U.S. Air Force Captain Joseph W. Kittinger, Jr., ascended to a new record height of 102,800 feet (31,333 meters). In 1961, Commander Malcolm Ross and Lieutenant Commander Victor A. Prather, Jr., of the U.S. Navy set the current official altitude record—113,739.9 feet (34,668 meters).

Long-distance balloon flights. In 1978, three American balloonists—Ben Abruzzo, Maxie Anderson, and Larry Newman—made the first crossing of the Atlantic Ocean in a balloon. Their helium balloon lifted off from Presque Isle, Maine, and landed about 60 miles (95 kilometers) west of Paris. In 1987, Per Lindstrand and Richard Branson of the United Kingdom crossed the Atlantic in a hot-air balloon. They traveled from Sugarloaf Mountain in Maine, to Limavady, Northern Ireland.

In 1999, Bertrand Piccard, a Swiss psychiatrist and the grandson of Auguste Piccard, and Brian Jones, a British pilot, became the first balloonists to fly around the world without landing. Their craft was a hybrid balloon with separate compartments containing helium and hot air. The helium provided most of the lift, but hot air helped control altitude. A thin layer of foam insulation surrounded the helium compartment. It helped prevent the helium from expanding and leaking out during the day and from contracting at night. This feature helped conserve fuel that the balloonists would have otherwise had to burn to keep the balloon aloft.

Piccard and Jones lifted off from Château-d'Oex in the Swiss Alps and landed about 300 miles (480 kilometers) southwest of Cairo, Egypt. Their balloon circled the earth, then continued on, setting official world records for distance and duration of flight. The balloon traveled 25,361 miles (40,814 kilometers) in 19 days 21 hours 47 minutes. The balloon also set an official record for the fastest circle around the earth—15 days 10 hours 24 minutes. This time was based on the fastest complete circle along the path of the trip. This circle began and ended over a point in the Atlantic Ocean near Mauritania. In 2002, Steve Fossett of the United States succeeded in his sixth attempt to become the first person to complete a solo balloon flight around the world. Fossett's balloon took off from Northam, Western Australia, and landed near Windorah, Queensland, Australia—traveling an unofficial distance of more than 21,109 miles (33,972 kilometers). The balloon unofficially completed its circle around the earth in 13 days 11 hours 33 minutes. Fossett's flight also set a new unofficial record for flight duration by a solo balloonist—14 days 19 hours 58 minutes.

Patrick J. Cannon

Related articles in *World Book* include:

Biographies

Blanchard, Jean-Pierre
Gay-Lussac, Joseph Louis
Montgolfier brothers
Piccard (family)
Zeppelin, Ferdinand von

Other related articles

Air force (History)
Airplane (First human flights)
Airship
Gas (Gas laws)
Helium (Uses)
Hydrogen (Uses)
Radiosonde
Stratosphere
Telemetry
Weather (Weather balloons, airplanes, and ships)

Outline

I. Kinds of balloons
A. Gas balloons
B. Hot-air balloons
II. How balloons are used
A. Scientific uses
B. Recreational uses
C. Other uses
III. History

Questions

What gases are used to inflate gas balloons?
What are some scientific uses of balloons?
Who made the first passenger-carrying balloons?
What is a *radiosonde* and what is it used for?
Why do balloons rise and float in the air?
What part did Jacques Alexandre Charles play in balloon history?
How have balloons been used in war?
At what times of day do most sport balloon flights take place?
How does a pilot control the vertical movement of a gas balloon? Of a hot-air balloon?

Additional resources

Perry, Phyllis J. *Ballooning.* Watts, 1996. Younger readers.
Ryan, Craig. *The Pre-Astronauts: Manned Ballooning on the Threshold of Space.* Naval Inst. Pr., 1995.

Ballot is the means by which voters indicate their choices in an election. The ballot may be a printed form that lists the candidates and describes issues that voters are to decide. It may also be set up on a voting machine. The voting machine was first used in 1892, and is now used by over half the voters in the United States.

In the United States, the written ballot was used in Massachusetts as early as 1634. By the time the Constitution was ratified, nearly all the original 13 states used written ballots. Before 1800, political groups distributed tickets that listed the names of candidates they favored. Voters could use these tickets as ballots but found it hard to vote for candidates not on the list. Sometimes they *scratched* the ticket, crossing off the party's choice and writing in another name.

Voters did not always have the privilege of a secret ballot, and coercion and bribery were common. To correct these evils, Kentucky and Massachusetts adopted the *Australian ballot* system in 1888. In this system, each voter receives a printed ballot at the polling place, and then marks it in secret in a curtained booth.

Some states use the *party column* ballot. On this ballot, candidates are listed according to party. This ballot makes it easier for voters to *vote a straight ticket* (vote for candidates of one party only). Other states use the *office-block* ballot. This ballot lists candidates according to the office they seek, making it easier for voters to vote for candidates from different parties. A ballot on which votes have been cast for candidates of different parties is called a *split ticket.* Because candidates whose names are first on a ballot often get the most votes, many states rotate the names as the ballots are printed.

Sometimes so many candidates are chosen at one election that ballots are several feet or a meter long. Some states have tried to simplify the ballot by reducing the number of offices filled by election. This *short ballot* centralizes the responsibility of government in a small body of elected officials, who appoint other officials.

Since the 1960's, people in many election districts have voted by punching holes in *punch-card ballots,* which are mounted on voting machines and counted by computer. The small piece of paper that is punched out of the card is called a *chad.* This method allows high-speed processing of election totals. But critics have argued that confusing ballot layouts can cause voters to accidentally punch their ballots incorrectly. In addition, computers may not properly count ballots if the chad have not been completely punched out. In 2000, debates regarding partially punched chad and a "butterfly" ballot layout—in which candidates' names were arranged on both sides of the chad-punching area—were largely responsible for a delay in the outcome of the presidential election. Some districts have switched to newer voting methods, such as touch-screen computer systems and optical-scanning ballot systems.

Older customs. The word *ballot* comes from the French word *ballotte,* meaning a *little ball.* In ancient Athens, judges of the highest court generally gave their verdicts by dropping stone or metal balls into boxes. Balls that were pierced in the center or colored black stood for verdicts of condemnation. Unpierced or white balls meant acquittal. Some clubs now use white and black balls to vote on new members. Persons not admitted are said to be *blackballed.*

The Romans generally used wooden tickets, or *tabellae.* When a change in law was proposed, those in favor marked the ballot with the letters *U R,* for *Uti rogas,* meaning *as you ask.* A vote against the change was indicated by the letter *A* for *Antiguo,* meaning *for the old.* In an election for public office, names of the candidates were written on ballots. During the Middle Ages, voting fell into disuse but was revived in the Italian communes in the 1200's. Ballots were used in England in the 1500's, and in the Netherlands in the 1600's. Robert Agranoff

See also **Voting; Voting machine** (picture).

Ballpoint pen. See **Pen.**

Ballroom dancing is a popular form of social dancing that has also become a competitive sport. Ballroom dancing usually involves a pair of dancers.

In competitive ballroom dancing, also called *DanceSport,* couples compete for titles and prizes at local, national, and international levels. The rules vary from country to country, and by the ages of the dancers. In the United States, youth and adult championship dance teams usually dance four or five dances in each of four main styles: (1) international standard, (2) international Latin, (3) American smooth, and (4) American rhythm. They may perform some dances, such as the waltz and tango, in more than one style, with different tempos, steps and rules. The required dances in the international standard style are the waltz, tango, Viennese waltz, slow fox trot, and quickstep. The international Latin dances are the samba, cha-cha (sometimes called the cha-cha-cha), rumba, paso doble, and jive. The American smooth category consists of a waltz, tango, fox trot, and Viennese waltz. The American rhythm dances are the cha-cha, rumba, East Coast swing, bolero, and mambo.

International DanceSport is governed by the International DanceSport Federation in Zurich, Switzerland. Amateur competition in the United States is governed by the United States Amateur Ballroom Dancers Association (also known as USA DanceSport), with headquarters in New Freedom, Pennsylvania.

Ballroom dancing probably originated in the late 1700's to early 1800's with the Viennese waltz. This dance, which featured fast, gliding turns, developed from the folk dances of southern Germany and Austria, and then spread to England and the United States. In the early 1900's, a vaudeville performer named Harry Fox performed a trotting dance that developed into the fox trot. About the same time, the ballroom dancers Vernon and Irene Castle imported the tango from Argentina to the United States. A faster version of the fox trot, called the *quickstep,* became popular in the United Kingdom. The rumba, from Cuba, gained popularity in the United States and Europe in the 1930's. The paso doble originated in Spain in the 1930's. The 1930's and 1940's saw the popularity of swing, jive, jitterbug, and a jitterbug variation called the Lindy. During the 1950's, several Latin dances became internationally popular, including the mambo, cha-cha, and bolero from Cuba and the samba from Brazil. Vivian M. Beiswenger

See also **Bolero; Dance** (picture); **Fox trot; Rumba; Tango; Waltz.**

Balm, *bahm,* also called *lemon balm,* is a tall herb of the mint family with a lemony fragrance. It grows 3 to 4 feet (91 to 122 centimeters) tall. It has wrinkled, egg-shaped leaves and small white flowers. Balm is native to

damp and shady woodlands of western Asia. It has long been grown in the Mediterranean region. Today, people who live in the eastern United States and along the West Coast grow balm as an herb for seasoning. Balm tea, which is used as a tonic, and balm wine and food flavorings are made from the leaves.

Donna M. Eggers Ware

Scientific classification. Balm is in the mint family, Lamiaceae or Labiatae. It is *Melissa officinalis.*

© Giuseppe Mazza

Balm leaves

See also **Herb; Mint.**

Balm of Gilead, also called *balsam Mecca,* is a resin that has been valued since ancient times for its fragrance and for its supposed value as a medicinal salve. It is obtained from the sap of a small evergreen tree found in Arabia and Ethiopia. It may be the balm mentioned in the Bible (Jer. 8:22; Ezek. 27:17). The name is also used for the aromatic substance taken from a variety of the balsam poplar.

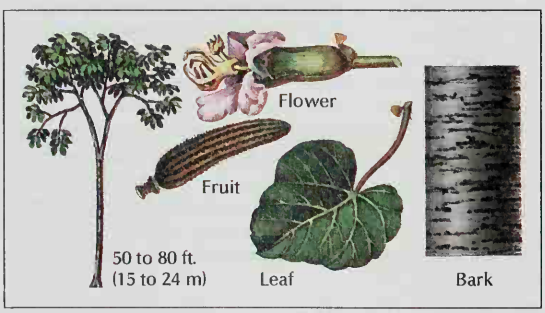
Balsa, *BAWL suh* or *BAHL suh,* is the lightest wood in commercial use. It comes from the balsa tree. Commercially traded, oven-dried balsa wood weighs from about 7 to 10 pounds per cubic foot (112 to 160 kilograms per cubic meter). The heavier kinds of balsa wood weigh as much as 20 pounds per cubic foot (320 kilograms per cubic meter). Balsa is light because air fills its large, hollow cells when the wood is dried out. The tree has large ivory-colored, vase-shaped flowers that produce its fruit and seeds.

Balsa gets its name from the Spanish word for *raft.* It was so named because the people of tropical countries have used the logs for rafts. Balsa grows from southern Mexico to northern Venezuela, and along the western coast of South America as far south as Bolivia. Large quantities of balsa are cut in Ecuador, the world's largest producer, and Costa Rica. The tree is widely cultivated on plantations.

Balsa wood has a silky sheen and feel. It is white to cream-colored, with a pinkish tinge in the inner parts of the trunk. The wood is used in making model airplanes and some kinds of boats, truck bodies, life rafts, and buoys. It also has been used as an insulating material in incubators, and in refrigerator cars and trucks.

Jim L. Bowyer

Scientific classification. The balsa tree belongs to the bombax family, Bombacaceae. Its scientific name is *Ochroma pyramidale.*



WORLD BOOK illustration by Chris Skilton

The balsa tree is a broadleaf tree that grows in Latin America. It has vase-shaped flowers that produce its fruit and seeds. People use balsa wood to make such products as model airplanes.

Balsam, Garden. See **Impatiens.**

Balsam fir is the name given to a number of evergreen trees in the pine family. The name usually refers to a medium-sized tree that is common in the northeastern and north-central parts of the United States and much of Canada. Pure stands of balsam fir grow in some areas, but the tree more often grows with white, black, and red spruces.

Mature balsam fir trees stand 40 to 60 feet (12 to 18 meters) tall. Balsam fir needles grow in two rows on hairy twigs. The needles are about 1 inch (2.5 centimeters) long with two silvery bands on their undersides.

The balsam fir has many uses. It ranks as the most popular Christmas tree in North America because of its cone shape and pleasant fragrance, and because it holds its needles for a long time after cutting. The fragrant needles of balsam fir can be dried and used as stuffing in sweet-smelling pillows. Resin found in blisters on the smooth gray bark is sold as *Canada balsam,* a useful transparent cement. Mature balsam firs are sometimes made into paper pulp. The trees are rarely used for lumber because the wood is light, weak, and soft. Other firs sometimes called balsam include the Fraser fir and the white fir. See also **Fir; Conifer.**

© Ray Brown, Morton Arboretum

© Robert P. Carr, Bruce Coleman Ltd.

The fragrant balsam fir, *left,* grows in the northeastern and north-central parts of the United States and throughout much of Canada. The needles of the balsam fir, *below,* grow in two rows on the twigs.

Douglas G. Sprugel

Scientific classification. The balsam fir belongs to the pine family, Pinaceae. Its scientific name is *Abies balsamea.*

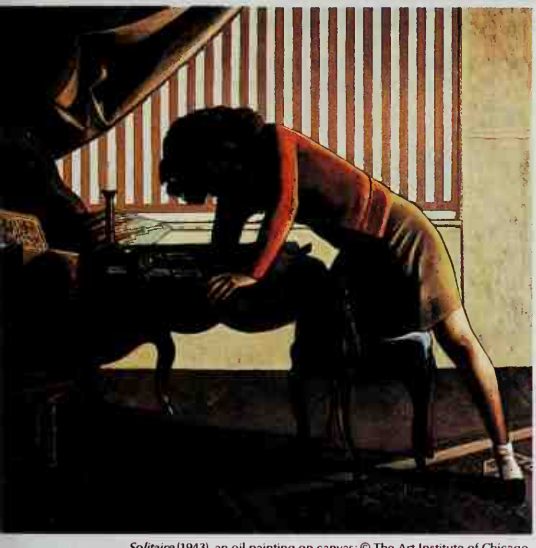
Balthasar. See **Magi.**

Balthus (1908-2001) was a French painter known for his eerie and provocative works. Unlike most modern artists, he did not belong to a particular group or move-

ment. Balthus was one of the relatively few figurative painters to emerge in the 1930's, when abstract painting was the dominant style. His paintings feature strongly outlined and distinct forms with smooth layers of overlapping paint and rich colors.

Balthus's paintings seem to stop time at an awkward moment—that is, when something in the scene is incorrect or inappropriate. His works fall into two general groups. One consists of outdoor scenes which often include figures conveying a sense of tension and menace. The other, more controversial, group emphasizes interior scenes of adolescent girls in sexually suggestive situations.

Balthus was born in Paris to Polish parents living there. His real name was Balthasar Klossowski de Rola. His father was a painter and an art historian, and his mother was also a painter. Balthus had little academic training and was largely self-taught. His early work was loosely allied with the surrealism movement (see **Surrealism**). His mature work developed into a more realistic style. Deborah Leveton



Solitaire (1943), an oil painting on canvas; © The Art Institute of Chicago, Joseph Winterbotham Collection. All rights reserved.

A Balthus painting portrays one of the artist's favorite subjects, an adolescent girl in an interior setting. Balthus created tension in the scene by showing the girl in an awkward position. Such paintings feature strong outlines and vivid patterns.

Baltic Sea is an arm of the North Atlantic Ocean that extends into northern Europe. It separates the Scandinavian Peninsula from the northern coast of Europe. It links Sweden, Finland, Russia, Estonia, Latvia, Lithuania, and Poland with the North Sea and the Atlantic.

The Baltic Sea has an area of about 160,000 square miles (414,000 square kilometers). It is about 950 miles (1,530 kilometers) long and about 400 miles (640 kilometers) across at its widest part. The Baltic coastline, including that of its gulfs and bays, is about 5,000 miles (8,000 kilometers) long.

There are important harbors at the cities of Copenhagen, Denmark; Gdańsk, Poland; Kiel, Germany;

WORLD BOOK map

The Baltic Sea is in northern Europe.

Klaipėda, Lithuania; Riga, Latvia; and Stockholm, Sweden. The Göta Canal provides a short cut from Sweden's Baltic coast to its west coast. The Kiel Canal connects the Baltic with the North Sea. There are narrow straits between Denmark and the Scandinavian Peninsula. These include the Great Belt and the Little Belt, and The Sound (Øresund), leading from the Baltic to the Kattegat.

Two long gulfs extend from the northern and eastern sides of the Baltic Sea. These are the Gulf of Finland and the Gulf of Bothnia. A chain of islands guards the entrance to the Gulf of Riga. The Aland Islands lie across the mouth of the Gulf of Bothnia. Osa E. Brand

Baltic States consist of the independent nations of Estonia, Latvia, and Lithuania. The three countries had been independent from 1918 until 1940, when the Soviet Union seized them and made them Soviet republics. In 1991, each of them broke away from the Soviet Union and became an independent nation again.

Before they became independent in 1918, the Baltic States had been ruled by the Danes, Swedes, Poles, Germans, and Russians. But Estonia, Latvia, and Lithuania each kept its own language, literature, and traditions. The three countries were part of the Russian czar's empire before World War I began in 1914. When the Russian Revolution of 1917 deposed the czar, the Baltic States demanded their independence. The Allied invasion of Russia aided the cause of the Baltic States.

In 1922, the Soviet Union was formed under Russia's leadership. During the 1930's the Baltic States balanced as best they could between Germany and the Soviet Union. In 1939, the Soviet Union demanded and received military bases in the Baltic States. Soviet forces occupied the three nations in 1940 and made them a part of the Soviet Union. German troops invaded the Baltic States in 1941, during World War II. However, they were driven out by the Soviets in 1944 and 1945. Until 1991, the region was a part of the Soviet Union. But in September 1991, all three of the countries became independent following an upheaval in the Soviet Union. In December of that year, the Soviet Union was dissolved.

Zvi Gitelman

See also **Estonia; Latvia; Lithuania.**

© Morton Tadder

Bruce R. Weller, The Rouse Company

Downtown Baltimore has a mixture of traditional and modern buildings. City Hall, *left*—built of white marble—was completed in 1875. The numerous shops and restaurants of Harborplace, *right*, attract many people. Part of the Inner Harbor development, Harborplace was completed in 1980.

Baltimore is the largest city in Maryland and one of the principal port cities of the United States. About half the people of Maryland live in the Baltimore metropolitan area. The city is Maryland's chief center of commerce, education, and industry.

Baltimore lies on the Patapsco River, about two-thirds of the way up Chesapeake Bay. It has one of the largest natural harbors in the world. Baltimore Harbor is the only U.S. port with two links to the Atlantic Ocean—the Chesapeake-Delaware Canal to the north and Chesapeake Bay to the south.

The Maryland colonial government founded Baltimore in 1729 as a trading center for the tobacco farmers of southern Maryland. These farmers had been attracted to the area by the natural harbor. The settlement was named Baltimore Town in honor of the Lords Baltimore, the family that founded the colony of Maryland.

Baltimore has played an important role in the history of the United States. During the Revolutionary War in America (1775-1783), the city served as the national capital for more than two months. Francis Scott Key, a Baltimore and Washington, D.C., lawyer, wrote "The Star-Spangled Banner" while on a ship in the harbor. He was inspired by the flag flying over Fort McHenry after a British attack during the War of 1812.

Baltimore grew steadily as a commercial center during the 1800's and early 1900's. In the 1950's, it began to face such problems as a housing shortage and a lack of funds to provide various public services. The city has worked to overcome these problems with urban renewal projects and efforts by private organizations.

Facts in brief

Population: *City*—651,154. *Metropolitan area*—2,552,994. *Consolidated metropolitan area*—7,608,070.
Area: *City*—85 mi² (220 km²). *Metropolitan area*—2,749 mi² (7,120 km²). *Consolidated metropolitan area*—9,578 mi² (24,807 km²), excluding inland water.
Climate: *Average temperature*—January, 37 °F (3 °C); July, 79 °F (26 °C). *Average annual precipitation* (rainfall, melted snow, and other forms of moisture)—44 inches (112 centimeters). For the monthly weather in Baltimore, see Maryland (Climate).
Government: Mayor-council. *Terms*—4 years for the mayor and 19 council members.
Founded: 1729. Incorporated as a city in 1796.

The city

Factories, metal refineries, shipyards and docks, and some low-income housing, cluster around parts of Baltimore Harbor. The Inner Harbor, a development project that covers about 240 acres (97 hectares), lies at the northwest end of the harbor. This famous example of urban planning includes Harborplace, a complex of shops and restaurants; the National Aquarium in Baltimore; the Baltimore Convention Center; and the 30-story World Trade Center and other office buildings. The Inner Harbor also includes hotels, a community college, recreational facilities, town houses, the Maryland Science Center, and the Christopher Columbus Center for Marine Biotechnology. Fort McHenry National Monument is on a peninsula in Baltimore Harbor.

The central business district lies in the south central part of Baltimore, just north of the harbor. This district includes City Hall, stores, and office buildings. Also in the area is Charles Center, a development that includes apartment and office buildings, a hotel, parks, stores, and a theater.

To the west of the Charles Center is the Baltimore Arena, an arena used for sports events and musical performances. Historic structures, including a monument to

George Washington, stand near the business district.

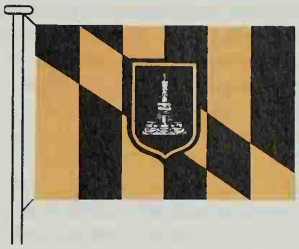
Baltimore is a city of varied neighborhoods. Areas of low-income housing projects stand near the central business district. Outside this inner core there are long stretches of row houses. Baltimore is famous for these houses, many of which have front steps made of marble. Many middle-income families have homes in northern Baltimore. The northwestern section of the city features apartment buildings and expensive houses.

The Baltimore metropolitan area covers 2,749 square miles (7,120 square kilometers) and takes in all of Anne Arundel, Baltimore, Carroll, Harford, Howard, and Queen Anne's counties. It extends south to the metropolitan area of Washington, D.C. The largest Baltimore suburbs are Columbia, Dundalk, Towson, and Essex. Several metropolitan areas form the Washington-Baltimore Consolidated Statistical Metropolitan Area. The metropolitan areas are those of Baltimore; Washington, D.C.; and Hagerstown, Maryland.

The people

Groups of various ethnic backgrounds occupy certain neighborhoods of Baltimore. There are several Polish and Greek neighborhoods in the eastern sections. Many Jewish people live in the northwest. A large number of Italian families live in an area near the harbor called "Little Italy."

During the mid-1900's, many blacks from the South and poor whites from Appalachia moved to Baltimore.



Symbols of Baltimore. The flag, *left,* shows the city's Battle Monument, which honors militiamen who defended the city in the War of 1812. The seal, *right,* includes the monument and the date 1797, when Baltimore formed its first city government.

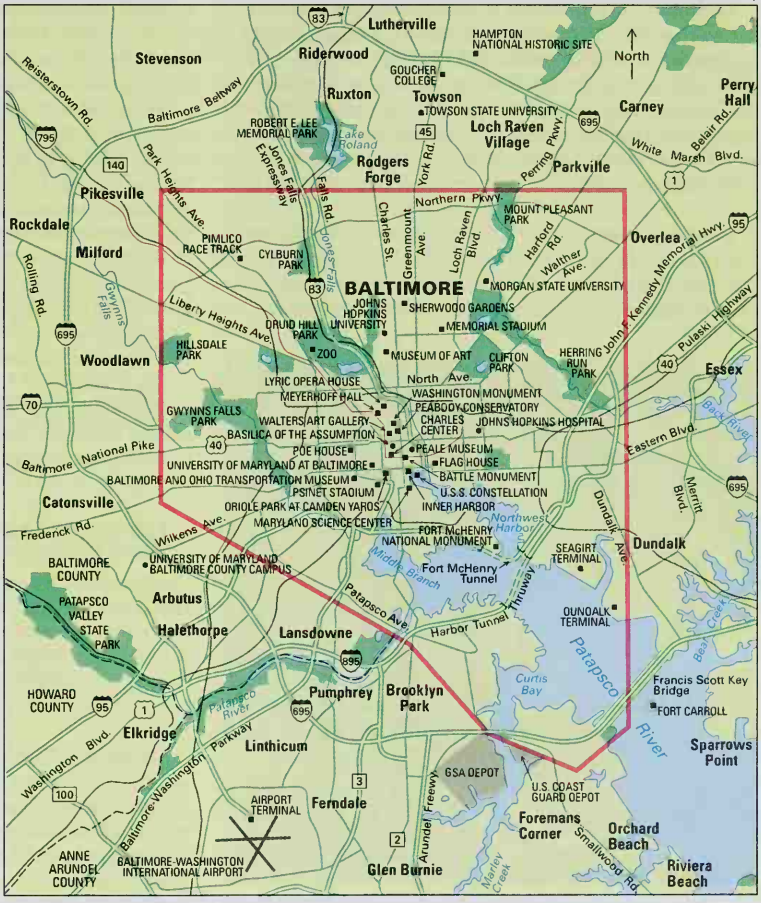
WORLD BOOK map

Baltimore

Baltimore lies in northern Maryland. The large map shows points of interest in the city. The small map shows the Baltimore-Washington, D.C., area.

City boundary
County boundary
Expressway
Other road
Railroad
Maryland mass transit (Metro)
Park
Military area
Point of interest

Baltimore and Washington, D.C., Area



Large black neighborhoods developed northwest and east of the central business district. In the 1960's, large numbers of white Baltimoreans moved to the suburbs. But whites began returning to the city in the late 1970's, when many old, run-down houses were restored. Today, blacks make up about 65 percent of Baltimore's population, and whites account for about 30 percent.

The city's population has dropped steadily since 1950. But the population of the metropolitan area has grown steadily since that time. Housing in the city deteriorated, and the increasing number of low-income families strained hospitals, schools, and other institutions. Baltimore has tried to fight these problems with federally aided antipoverty programs and urban renewal projects.

Roman Catholics make up the largest religious group in Baltimore. Baptists and Lutherans rank as the next largest groups. The city also has many Methodists and Jews. The first Roman Catholic archdiocese in the United States was established in Baltimore in 1789. The nation's first major Catholic cathedral, the Basilica of the Assumption of the Blessed Virgin Mary, was dedicated there in 1821. Old Otterbein United Methodist Church, built in 1785, is the oldest church in the city.

Economy

Shipping. Baltimore has one of the world's largest natural harbors. The port has 45 miles (72 kilometers) of waterfront, with 1,589 acres (643 hectares) of water where ships can anchor. The Maryland Port Administration supervises the area. The port handles about 25 million tons (23 million metric tons) of cargo annually. Imports include automobiles, iron ore, sugar, and wood pulp. Exports include coal, electrical equipment, and grain.

Industry. The Baltimore area has over 2,000 factories. It is ranked as one of the largest industrial employers on the East Coast. Leading industries include the production of radar and other electronic equipment, and of steel, power tools, and raincoats. The Bethlehem Steel plant in Sparrows Point, 10 miles (16 kilometers) east of Baltimore, is one of the world's largest steel producers. Other leading industries produce chemicals, fabricated metal products, food and food products, and machinery. McCormick & Company, the world's largest producer of spices and seasonings, is in Baltimore.

Transportation and communication. The Baltimore-Washington International Airport lies 10 miles (16 kilometers) south of Baltimore. Freight railroads and about 150 truck lines serve the city. High-speed passenger trains connect Baltimore with Boston, New York City, Philadelphia, and Washington, D.C. Baltimore's highway system includes two tunnels under the harbor. The State of Maryland Mass Transit Administration (MTA) operates buses and rapid-transit trains for local transportation in the metropolitan area.

The city has two daily newspapers, *The Sun* and *The Daily Record*. About 20 radio stations and 5 television stations serve Baltimore.

© James Blank, West Stock

Fort McHenry, in Baltimore, includes the original fort, built in the 1790's. Near the fort flies a replica of the flag that inspired Francis Scott Key to write the national anthem.

Education

Baltimore has about 180 public schools. Approximately 110,000 students attend these schools. The Archdiocese of Baltimore operates a total of about 100 Roman Catholic schools in the city and eight nearby counties of its jurisdiction. These schools serve about 34,000 students. Baltimore has about 35 other private schools, with about 5,000 students.

Baltimore is the home of several famous colleges and universities. Johns Hopkins University and its medical center have won fame throughout the world. Other institutions include Goucher College, a private college in suburban Towson; and Morgan State University, one of the nation's oldest and most noted black schools. The Peabody Conservatory of Music is also well known. The University of Maryland System has two campuses in the area—the University of Maryland at Baltimore and the University of Maryland, Baltimore County, in Catonsville. The University of Baltimore is in the city.

The Enoch Pratt Free Library, founded in Baltimore in 1886, is one of the oldest public library systems in the United States. Its main library, 30 branches, and a bookmobile house about 2,200,000 volumes.

Cultural life

The arts. The Baltimore Opera Company performs in the Lyric Opera House, and the Baltimore Symphony Orchestra performs in the Joseph Meyerhoff Symphony Hall. The Peabody Conservatory sponsors other musical programs. Musical shows ranging from opera to rock concerts are presented in the Baltimore Arena. The Morris A. Mechanic Theater offers dramas and musicals, and the Center Stage performs plays in its own building.

Museums. Baltimore has two outstanding art museums. The Baltimore Museum of Art is famous for its collection of modern art. It also features works from earlier periods. The Walters Art Gallery, which owns about 25,000 art objects, features medieval and Chinese art. The Peale Museum, which opened in 1814, specializes in the life and history of Baltimore. Its building was the first in the United States to be designed as a museum. The municipal government operates the Peale and four

other museums as The City Life Museums. These museums include the home of American critic and journalist H. L. Mencken. The Maryland Historical Society displays the original manuscript of "The Star-Spangled Banner." The Baltimore and Ohio Transportation Museum houses a collection of early railroad cars and engines. The Maryland Science Center includes a science museum, a planetarium, and an observatory. It is the home of the Maryland Academy of Sciences.

Recreation

Parks. Baltimore's park system consists of almost 70 parks that cover nearly 6,000 acres (2,400 hectares). The city's largest park is Gwynns Falls Park, which occupies 686 acres (278 hectares). Druid Hill Park includes the city zoo.

Other public recreation areas in the city include playgrounds, golf courses, swimming pools and beaches, skating rinks, and shooting ranges. Sherwood Gardens, a private garden open to the public, features displays of azaleas, pansies, and tulips.

Sports. Baltimore is the home of baseball's Baltimore Orioles of the American League. The Baltimore Ravens of the National Football League also are based in the city. Pimlico Race Track features the annual Preakness Stakes, the second event in the Triple Crown of U.S. horse racing.

Other interesting places to visit include:

Babe Ruth House, the birthplace of the famous baseball player. The restored house contains mementos of Ruth.

Battle Monument, the first major war memorial in the United States. It honors Baltimore soldiers who died during a British attack in 1814. Maximilian Godefroy, a French artist, designed the monument, which was completed in 1825.

Fells Point, Baltimore's original port, east of the Inner Harbor. Fells Point is now a pleasant neighborhood of restored homes and of restaurants, bars, and shops.

Fort McHenry, where American troops fought British warships in 1814, as described in "The Star-Spangled Banner." It was built in the 1790's and became a national monument in 1939.

Harborplace, in the Inner Harbor area, an enclosed modern complex of shops and restaurants.

National Aquarium in Baltimore, which features an artificial tropical rain forest, a coral reef, and thousands of fish, reptiles, and birds.

Poe House, a brick building where the American writer Edgar Allan Poe lived from 1832 to 1835. Poe is buried in Baltimore's Westminster Churchyard.

Star-Spangled Banner Flag House, the home of Mary Pickersgill, a seamstress, who made the flag described in "The Star-Spangled Banner."

U.S.S. *Constellation,* launched in 1854, was the last U.S. Navy warship completely powered by sails. It was rebuilt in the late 1990's to serve as a museum ship. See **Constellation.**

Washington Monument, the first major monument dedicated to President George Washington. Robert Mills, an American architect, designed the marble structure, which was completed in 1842.

Government

Baltimore is not in any county, nor is it a county itself. But the city has the same powers as do Maryland's 23 counties. For example, Baltimore sends representatives to the state legislature.

The city has a mayor-council form of government. The mayor and the council members all serve four-year terms. Baltimore voters elect three council members from each of six districts. They also choose a council president in a citywide election. The council passes laws and approves the city budget. The mayor appoints department and commission heads, subject to the approval of the council. Property taxes provide Baltimore's main source of income.

History

Early days. The Susquehannock Indians lived in what is now the Baltimore area before white settlers came in 1661. But Baltimore was not founded until 1729. That year, the Maryland General Assembly bought a 60-acre (24-hectare) tract at the head of the Patapsco River and named it Baltimore Town.

The Assembly intended the town to be a trading center for the tobacco plantations of southern Maryland. But the town soon began to handle other products, including wheat from Pennsylvania and coffee from South America. By the late 1700's, flour milling and the export of wheat and flour provided Baltimore's main income.

Baltimore served as the national capital for more than two months during the Revolutionary War in America. The Continental Congress fled there in 1776 when British troops threatened Philadelphia. Baltimore was incorporated as a city in 1796.

The 1800's. By 1800, Baltimore had a population of 35,514. During the War of 1812, armed merchant ships called *privateers* sailed from Baltimore Harbor and attacked British shipping in the Atlantic. As a result, the city became a target for British revenge. On Sept. 12, 1814, British troops attacked Baltimore by land. The next day, the British fleet began to bombard Fort McHenry. The city drove back both attacks. The sight of the flag waving over Fort McHenry after the bombardment inspired Francis Scott Key to write "The Star-Spangled Banner."

The National Road, begun in 1811, opened Midwestern markets to Baltimore by connecting Maryland with the Ohio Valley. The city became the leading port for Midwestern trade because it lay closer to the Midwest than other Atlantic ports.

During the 1820's, construction of the Erie Canal threatened Baltimore's position as a leader in trade. The canal provided rapid transportation from the Great Lakes to New York City. But railroads built in the 1830's helped the city maintain its trading importance. For a time in 1830, the *Tom Thumb,* the first American-built steam locomotive, operated from Baltimore. That year, the Baltimore and Ohio Railroad became the first U.S. railroad to carry passengers.

Clipper ships built in Baltimore carried flour, tobacco, and wheat from the city to Europe and South America and returned with coffee, copper, hides, and sugar. Baltimore became the nation's largest coffee market and a major processor for many agricultural products. It also became a banking center, with heavy investments in the South. Many German and Irish immigrants settled in the city during the 1840's and 1850's. By 1860, Baltimore ranked as the third largest city in the country, with 212,418 people.

Maryland remained in the Union during the Civil War (1861-1865), but many Baltimoreans sympathized with the Confederacy. On April 19, 1861, a mob of Southern supporters attacked Union soldiers passing through the

city. Four of the soldiers and 12 citizens were killed. Union troops occupied Baltimore from May 1861 until May 1865. During this period, some city officials were kept in jail as Southern supporters.

After the war, Baltimore continued its commercial and cultural expansion. In 1873, a Baltimore merchant named Johns Hopkins died and left $7 million to build a university and hospital. Johns Hopkins University was established in 1876, and the hospital in 1889. See **Hopkins, Johns.**

The 1900's. Baltimore had a population of 508,957 by 1900. The large immigration of Germans and Irish was followed by the arrival of Czechs, Italians, and eastern European Jews. The city's borders expanded and suburbs appeared.

On Feb. 7, 1904, the Great Baltimore Fire broke out in the heart of the downtown area. The fire, Baltimore's worst disaster, burned for two days and spread over 140 acres (57 hectares). It destroyed nearly every major downtown building. Although no homes or lives were lost, the fire caused damage totaling over $100 million.

By the time World War I began in 1914, all damage from the fire had been repaired. New industries, together with trade, made Baltimore more prosperous than ever. Between 1888 and 1918, the city expanded its boundaries by annexing part of Baltimore County. During World War II (1939-1945), Baltimore's manufacturing plants produced huge quantities of airplanes, chemicals, electronic equipment, ships, and steel. Large numbers of Southern blacks and Appalachian whites moved into the city to work in Baltimore's expanding industries. By 1950, the population of Baltimore reached 949,708.

Recent developments. Since the 1950's, Baltimore has carried out major programs of urban renewal. Friendship International Airport (now Baltimore-Washington International Airport) opened in 1950. That year, workers also began to clear slums for other construction projects. These projects included expressways, new office and apartment buildings, and expansion of Johns Hopkins Hospital.

The Baltimore Arena opened in 1962, and the Charles Center complex was completed in 1974. The Inner Harbor program was begun in 1967. The original program was completed in the mid-1980's, but further construction is planned. In 1992, the baseball stadium Oriole Park at Camden Yards opened. Mike Bowler

See also **Key, Francis Scott; Maryland; Star-Spangled Banner; United States, History of the** (picture: Many of the early settlers).

Baltimore, Lord, was the title of six members of the Calvert family. They are best known as the founders and proprietors of the colony of Maryland. See **Calvert, Cecilius; Calvert, Charles; Calvert, George.**

Baltimore oriole is a songbird that lives in North and South America. It is also called *Hangbird, Firebird,* or *Golden Robin.* The Baltimore oriole is known for its beautiful feathers and its musical whistle. For many years, this bird was considered a separate species of oriole. Today, it is regarded as a subspecies of the northern oriole and bird specialists refer to it by the name *northern oriole.* However, the bird is still commonly known as the Baltimore oriole.

The bird was named for George Calvert or Cecilius Calvert, the first two Lords Baltimore. The Calverts were important in the development of the colony of Maryland, one of the first places the bird was spotted by European settlers. The bird's orange and black colors resembled those on the Calvert coat of arms. In spring and summer, the bird lives in the central and eastern United States and southern Canada. In the fall, the Baltimore oriole flies south, and spends the winter from southern Mexico to Colombia and Venezuela.

The male is 7 to 8 inches (18 to 20 centimeters) long. His head and back are a glossy black. His wings have white bars, and his breast is bright orange. The female is smaller and is not so colorful. Her back is brown and her breast either yellow or dull orange.

The Baltimore oriole's nest is a hanging pouch. It is 4 to 6 inches (10 to 15 centimeters) deep and hangs from the tip of a tree limb. It is usually made of grapevine, strips of bark, vegetable fibers, string, and hair.

Baltimore orioles lay from four to six eggs at a time. The eggs are about 1 inch (2.5 centimeters) long and are dull white with dark irregular lines down the sides. Baltimore orioles eat insect pests, such as caterpillars. The Baltimore oriole is the state bird of Maryland.

Scientific classification. The Baltimore oriole is in the icterid family, Icteridae. It is *Icterus galbula.* Donald F. Bruning

See also **Bird** (pictures: Birds of forests and woodlands; Birds' eggs); **Oriole.**

Balzac, *BAL zak* or *BAWL zak,* **Honoré de,** *AHN uh RAY duh* (1799-1850), a French writer, was one of the most important novelists of the 1800's. He was the first great writer to reveal the complex bonds that tie people to society, and to explore the deep influence of environment on human beings.

Balzac's fame rests on *The Human Comedy* (*La Comédie Humaine*), a series of nearly 100 works, including novels, novellas, and short stories. In writing *The Human Comedy,* Balzac tried to discover and expose the factors governing French life between the revolutions of 1789 and 1830. His plots often are only devices to illustrate the vast social, political, and economic movements dominating France during that time.

Balzac introduced into his writings as many occupations, professions, and levels of society as he could. *The Human Comedy* has more than 2,000 characters, many of whom appear in two or more books. This gives the series a strong sense of continuity and unity. Balzac arranged *The Human Comedy* into "scenes" of private life (*Old Goriot,* 1834); provincial life (*Eugénie Grandet,* 1833); Parisian life (*Cousin Bette,* 1846); military life (*The Chouans,* 1829); political life (*A Gloomy Affair,* 1841); and philosophical studies (*In Quest of the Absolute,* 1834). His style is often rough, his plots too involved, and his descriptions tedious. *The Human Comedy* endures because of its powerful drama, epic realism, and portraits of people in action.

Giraudon/Art Resource

Honoré de Balzac

Balzac also wrote *Droll Stories* (1832-1837), a collection of racy tales influenced by the work of François Rabelais. He also

wrote many plays and contributed historical and political articles to many magazines.

Balzac was born in Tours. His childhood was unhappy, both at home and in school. He studied law in Paris from 1816 to 1819, and then decided to become a writer. Balzac filled the remaining 30 years of his life with writing, wild money-raising schemes, and affairs with women. His urge for wealth and power led him into a series of disastrous financial speculations that left him deeply in debt. To pay his bills, he wrote furiously. He often wrote more than 16 hours a day for weeks at a time, keeping himself awake with coffee. The novel *The Chouans* brought him his first fame. Despite his many friendships with women, Balzac did not marry until a few months before his death. Thomas H. Goetz

Additional resources

Festa-McCormick, Diana. *Honoré de Balzac.* Twayne, 1979.
Kanes, Martin, ed. *Critical Essays on Honoré de Balzac.* G. K. Hall, 1990.
Pritchett, V. S. *Balzac.* Knopf, 1973. A classic biography.
Robb, Graham. *Balzac.* 1994. Reprint. Norton, 1996.

Bamako, *BAH MAH KOH* (pop. 658,275), is the capital of Mali. It lies in the southwestern part of the country, along the Niger River and at the foot of the Manding Plateau. For location, see **Mali** (map).

Bamako serves as an administrative and commercial center. Mali's government headquarters lie about 2 miles (3 kilometers) north of the city. Bamako's educational institutions include a teacher-training college, a civil engineering school, and a medical school. The city's factories process food and produce leather, textiles, and plastic products. Bamako has an international airport, and a railroad connects the city with the city of Dakar, Senegal, on the west coast of Africa.

France gained control of what is now Mali in the late 1800's. At that time, Bamako was a small village with walls around it. In 1908, Bamako became the capital of the French colony of French Sudan. In 1960, Mali became an independent nation, with Bamako as its capital.

Lansiné Kaba

See also **Mali** (picture: A street market).

Bamboo is a giant grass noted for the usefulness of its hollow, woody stem. Bamboos are distantly related to wheat, oats, and barley. But unlike these crop grasses, most bamboos are of giant size. Some may stand as much as 120 feet (37 meters) high and have stems 1 foot (30 centimeters) in diameter. Bamboo stems are used as fishing poles and in ornamental screens, cooking utensils, tools, baskets, and building material.

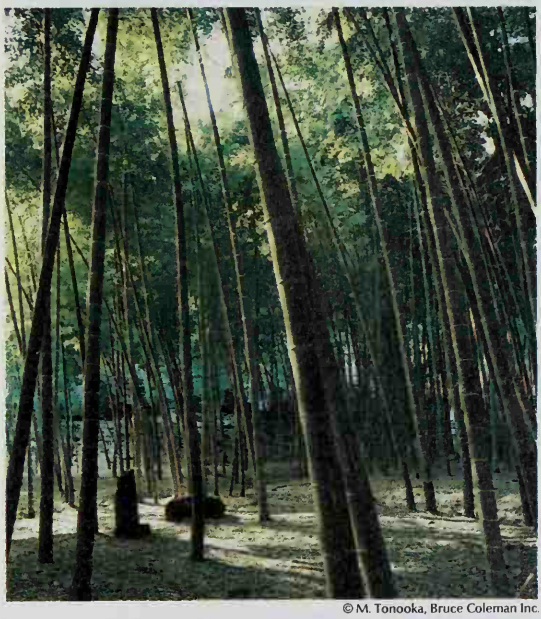
Scientists rank bamboos among the most primitive of grasses. There are more than 700 *species* (kinds) of bamboos. Most grow naturally in tropical climates or in the warm regions of temperate climates. Two small bamboos are native to the United States. They grow in the southeastern states, in thickets known as *canebrakes.*

How bamboo is used. Bamboo provides many essential articles for people who live in tropical countries, especially Asian lands. Farmers may live in bamboo houses, sit on bamboo chairs, and eat food prepared in bamboo containers. Their beds and covers may be bamboo mats. They wear sandals woven from bamboo strips. Bamboo cages hold chickens and pigs, and a bamboo fence may enclose a yard. Bamboos provide shade, and tender young bamboo sprouts are eaten as vegetables. Rafts, sails, towrope, paper, and tools are also made from bamboo. Bamboo probably has more uses than any other substance in tropical countries.

Bamboos have been grown in the United States mostly for ornament. The United States Department of Agriculture maintains a bamboo garden near Savannah, Georgia. There, experts grow bamboo and test it. They have found that the closely matted roots help control soil erosion, and the high cellulose content of bamboo stems makes excellent pulp for paper. Construction engineers also use bamboo. Experts who compared the strength of *laminated* (layered) bamboo with soft steel found that the bamboo's breaking point nearly equaled that of the steel. The strong, lightweight bamboo makes an excellent reinforcement for concrete.

How bamboo grows. Bamboo usually grows from new shoots that sprout from the base of the mature plant. The shoots grow quickly. One bamboo grew 36 inches (91 centimeters) in 24 hours. Not all of these plants grow that fast, but they reach full height within a few months. Old clumps that have stored much food produce the largest and tallest bamboos.

The jointed stem never gets thicker after a bamboo is full grown. Bamboo stems do not add a ring of growth each year as tree trunks do. Bamboo leaves are long and



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The bamboo is a type of giant grass that grows in groves. Its tall, straight, hollow stem has hard, thick joints. Most bamboo grows in a wild state in tropical climates or in warm regions of temperate climates.

WORLD BOOK photo

narrow and grow alternately in two rows on opposite sides of the stem. When the leaves mature, the blades usually fall off, leaving the sheathlike base.

Bamboos rarely bloom. Among most bamboos, different plants of the same species flower *synchronously* (at the same time) no matter where they grow. Bamboos bloom at intervals of from 10 to 120 years, depending on the species. Even if they are transplanted to other continents, these plants will flower at the same time. Bamboo plants usually die after they bloom. New plants grow from the seeds, which look like rice kernels. In 1990, scientists announced development of a technique that causes bamboo to flower rapidly. This discovery may enable scientists to breed a type of bamboo that grows and reproduces faster than other bamboos.

Alwyn H. Gentry

Scientific classification. Bamboo is a member of the grass family, Poaceae or Gramineae. Common genera include *Phyllostachys, Arundinaria, Bambusa,* and *Dendrocalamus.*

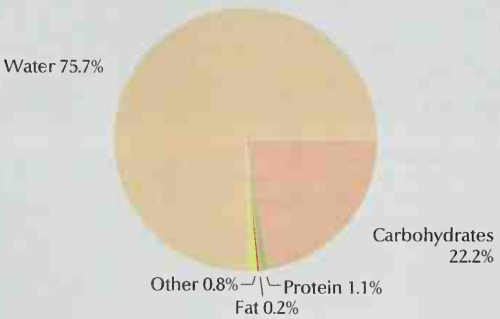
Banana is a nourishing fruit that grows in the tropics and is popular throughout the world. The banana plant grows from 8 to 30 feet (2.4 to 9 meters) tall, depending on the variety, and looks like a tree. But it is not a tree because it has no woody trunk or boughs.

People in the United States eat about 11 billion bananas annually. Most of these bananas are eaten as snacks or in cereal, fruit cocktails, and salads. Bananas are also used in cakes and pies. Bananas are rich in carbohydrates. They also contain phosphorus, potassium, and vitamins A and C. Dried bananas are eaten as a snack and are made into flour.

Most bananas eaten in the United States have smooth yellow skin. The most important banana varieties are *Dwarf Cavendish, Williams,* and *Grand Nain.* Two varieties popular in other countries are *Apple* and a small red banana called the *Red Jamaica.* These fruits are rarely seen in the United States because they are too thin-skinned to be shipped safely. A large type of banana called the *plantain* is hard and starchy when unripe and is almost always eaten as a cooked vegetable.

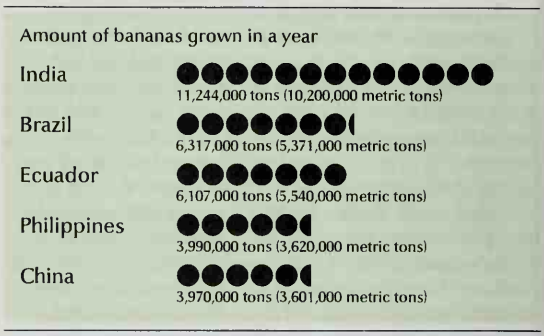
The food value of the banana

Ripe bananas contain many nourishing ingredients. A high carbohydrate content makes them a good energy source.



Source: U.S. Department of Agriculture.

Leading banana-growing countries



Figures are for a three-year average, 1997-1999.
Source: Food and Agriculture Organization of the United Nations.

Generally, only the fruit of the banana plant is used. But the leaves of some kinds of banana plants contain useful fibers. People in many tropical countries use the leaves of these plants to build roofs for houses and to make bags, baskets, and mats.

How bananas grow. Bananas grow in hot, damp climates and thrive in rich, sandy loam soil that has good drainage. The fruit originated in Asia but is now raised in the tropics of both the Eastern and Western hemispheres. India is the leading banana producer, followed by Brazil, Ecuador, the Philippines, and China. Latin American countries supply more than 90 percent of the bananas eaten in North America.

Banana farmers start a crop by cutting growths from the *rhizomes* (underground stems) of mature banana plants. These growths, called *suckers,* are planted in the ground. Three to four weeks later, leaves begin to unfold from the suckers. The young plants rapidly increase in size. Fully expanded leaves on mature plants look like large drooping feathers. They range from 6 to 10 feet (2 to 3 meters) long and from 1 to 2 feet (30 to 60 centimeters) wide. The "trunk" of a banana plant consists of a hollow column that is formed from the tightly wrapped stalks of the leaves. The trunk is also called a *pseudostem.*

When the plant is about 10 months old, a stem bearing a large bud grows through the center of the pseudostem. Many small purple leaves called *bracts* surround the stem. After the stem grows through the top of the plant, the bracts roll back, revealing clusters of small flowers. These flowers develop into tiny green bananas. Each cluster is called a *hand* and consists of 10 to 20 bananas, which are known as *fingers.* At least five hands of bananas grow on the stem of each banana plant.

In time, as the fingers enlarge, the stem droops toward the ground and the bananas begin to curve upward. Bananas ripen unevenly after five or six months if left on the tree. When completely ripe, the fruit fall to the ground and must be eaten immediately or they will spoil. Therefore, bananas that will be exported are harvested after about three months, while still green.

Bananas are transported directly from the field to refrigerated containers on ships within 24 hours after harvesting. During shipping, the fruit are kept at a tempera-

G. R. Roberts

J. Kraay, Bruce Coleman Inc.

Bananas grow in many warm regions. Each banana plant includes a large bud at the end of a stem. As the stem grows, leaves covering the bud peel back, revealing flowers. The flowers grow into tiny bananas, *left.* The bananas grow in bunches, *right,* and are cut down just before ripening.

ture of 57 to 59 °F (14 to 15 °C). After reaching their destination, bananas are unloaded into temperature-controlled ripening rooms. The ripening process begins several days before the bananas are sent to markets. A small quantity of a gas called *ethylene* is introduced into the storage rooms. Ethylene stimulates ripening of the fruit. Gradually, during the following days, the green bananas turn uniformly yellow with brown specks. The bananas are then ready to be eaten.

A fungus disease called *Panama disease* destroys some varieties of bananas. Plants affected by this disease are replaced by varieties that can resist the fungus. The most serious threat to banana production is *Sigatoka disease,* also caused by a fungus. This disease can be controlled if chemical sprays are used soon enough. Another banana plant disease, *Moko disease,* is caused by bacteria. It can be controlled by removing the affected plants. Moko disease is spread by insects that feed on banana flowers.

The banana industry. Until about 1860, bananas were eaten largely by people of the tropics. At that time, several merchants in Europe and the United States realized that exporting bananas could be profitable. They founded companies and established large commercial banana plantations.

The first banana plantations were difficult to build. The banana companies cleared away jungles, drained the swampy coastal regions, and constructed roads, railroads, and communication facilities. They also built villages for their workers and established steamship lines to transport bananas throughout the world.

Through the years, banana companies bought more and more land in the banana-growing countries. By the 1890's, the first firms had expanded into or had been replaced by huge international corporations. The villages grew into independent communities with housing, schools, stores, and hospitals for the workers and their families.

Today, the corporations control most of the $400-million annual world banana trade. They strongly influence the economies and politics of the nations in which they operate. In 1974, to balance the power of the corporations, many banana-growing countries formed a business league called the Union of Banana Exporting Countries. The league has demanded—and won—higher banana prices and workers' wages. In 1984, several countries that fund international agricultural research established the International Network for the Improvement of Banana and Plantain. This group supports research for improving banana and plantain production and collects and exchanges information about these crops.

Scientific classification. Bananas belong to the genus *Musa* in the banana family, Musaceae. Richard E. Litz

Banaras. See Varanasi.

Bancroft, George (1800-1891), was an American historian and diplomat. He became one of the most outstanding historians of the 1800's, a reputation based largely on his 10-volume *History of the United States* (1834-1874). The work earned high praise for its contribution to an understanding of the American point of view during the 1800's. Bancroft viewed the nation's history as evidence of a divine plan for freedom and equality. His *History* and other works demonstrate his view of progress, in which the idea of American democracy represented the highest form of civilization.

Bancroft was born in Worcester, Mass., and was educated at Harvard University and in Germany. In 1823, he helped found the Round Hill School, a progressive school for boys, at Northampton, Mass. Bancroft taught at the school for eight years. He then devoted the rest of his life to politics, diplomacy, and writing. Bancroft's strong support of the Democratic Party earned him a number of political appointments. In 1845 and 1846, he served as secretary of the Navy under President James K. Polk. He founded the United States Naval Academy at Annapolis in 1845. From 1846 to 1849, Bancroft represented the United States as minister to Great Britain. He served as the U.S. minister to Germany from 1867 to 1874. Robert C. Sims

Band is a group of musicians who play mainly brass, woodwind, and percussion instruments. Bands differ from orchestras, which include a section of stringed instruments. But some bands use strings occasionally.

Groups of musicians playing percussion and woodwind instruments date back to earliest times. These

groups usually performed during festivals and religious ceremonies. Bands became established as distinct musical organizations during the 1800's. The development of bands at that time was largely aided by technical improvements in musical instruments, such as the invention of valves for brass instruments.

Today, there are many types of bands. They play a wide range of music and perform on a variety of occasions. The most popular kinds of bands include military bands, marching bands, concert bands, wind ensembles, jazz bands, and dance bands.

Military bands, the first type of band, originated in the 1700's. The earliest military bands were established during the reigns of two European kings, Louis XIV of France and Frederick the Great of Prussia. During the late 1700's, the rulers of Great Britain and other European nations also began to sponsor military bands. These bands led troops in marching and helped promote a patriotic spirit among both soldiers and civilians.

In the mid-1800's, European military bands began to present concerts for civilians. British bands served as the basis for the military and concert bands that later were organized in the United States. Today, all branches of the U.S. armed forces have bands that perform at military and civilian functions. Most military bands have about 60 members.

Marching bands. The members of a marching band march while they play, though they can perform while standing. These groups resemble military bands. However, the musicians in marching bands generally wear more colorful uniforms and use faster tempos. Marching bands may also feature drum majors, baton twirlers, flag and rifle corps, and even lines of dancers.

Marching bands often play while performing a precision drill. In the United States, high school and college marching bands are featured at football games. The musicians may arrange themselves into various formations and designs, or into letters or words. The size of a marching band can vary greatly, with the largest having more than 300 members.

Cameramann International, Ltd. from Marilyn Gartman

Marching bands are a popular feature of parades and outdoor sports events. These colorfully dressed bands consist primarily of brass, woodwind, and percussion instruments.

Concert bands, sometimes called *symphonic bands,* play while seated before an audience. They became popular in the United States after the end of World War I in 1918. A concert band can have from 50 to more than 100 musicians.

The first American concert bands performed classical orchestral transcriptions. Gradually, a number of major composers began to write band music. They included Gustav Holst of Great Britain, Morton Gould of the United States, and the Russian-born Igor Stravinsky. Today, nearly all high schools and colleges in the United States have a concert band. Many cities and towns also support community concert bands, especially in the summer.

Wind ensembles have the same instrumentation as concert bands, but there are fewer musicians. Wind ensembles generally consist of fewer than 50 members with one musician per part except for the clarinet section, where some doubling of parts can occur. The percussion section plays a key role in wind ensembles.

The earliest wind ensembles were established in the United States during the mid-1900's. The first influential wind ensemble leader was Frederick Fennell. He directed the Eastman Symphonic Wind Ensemble at the University of Rochester from 1952 to 1962.

The popularity of wind ensembles stimulated a new interest in band music among many composers. They believed the smaller size of wind ensembles offered greater flexibility and freedom. Since the mid-1900's, almost all significant band music has been written for wind ensembles. Leading composers of wind ensemble music include Krzysztof Penderecki of Poland and Warren Benson, Ingolf Dahl, Walter Hartly, Karel Husa, George Rochberg, and Gunther Schuller of the United States.

Jazz bands developed primarily from black brass bands of the late 1800's. Jazz bands include a *rhythm section,* generally made up of piano, string bass, and drums. These bands have a variety of other instruments, depending on the type and style of jazz being played. For example, most groups that play Dixieland jazz, a lively style associated with New Orleans, consist of trumpet, trombone, clarinet, and a rhythm section. Famous leaders of Dixieland bands have included Louis Armstrong, King Oliver, and Kid Ory. Large jazz bands may have three to five trumpets, two to four trombones, four or five saxophones, and a rhythm section. Leaders of professional jazz bands have been Count Basie, Duke Ellington, Maynard Ferguson, Benny Goodman, Fletcher Henderson, Woody Herman, and Stan Kenton.

Dance bands play for dancing rather than for listening. The number and type of instruments in most dance bands resemble those of large jazz bands. Some big jazz bands may play dance music as well as jazz.

Dance bands reached their greatest popularity during the 1930's and 1940's. Most of the bands of that era performed in ballrooms and hotels, and many played a rhythmic type of music called *swing.* Leaders of popular swing bands included Tommy Dorsey, Benny Goodman, Glenn Miller, and Artie Shaw. Other bands played traditional dance music, such as waltzes and other *sweet* tunes. Among the leaders of popular sweet bands were Sammy Kaye, Wayne King, Guy Lombardo, and Lawrence Welk.

Stewart L. Ross

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Drum and bugle corps	Jazz	Orchestra
Gilmore, Patrick S.	King, Karl	Rhythm band
Goldman, Edwin F.	March (music)	Sousa, John Philip
	Miller, Glenn	

Banda, *BAN duh,* **Hastings Kamuzu,** *kah MOO zoo* (1898-1997), was the leader of Malawi from 1963 to 1993. He became prime minister in 1963 and led Malawi—then a British protectorate of Nyasaland—to independence in 1964. In 1966, the Malawi Congress Party became the country's only legal political party. It declared Banda president that year. As president, Banda encouraged the development of agriculture, which kept many laborers from leaving the country to find work in neighboring lands. In 1970, a constitutional amendment made Banda president for life. In 1993, it was repealed, and Malawi's people voted for a multiparty system. In 1994, Bakili Muluzi, leader of the United Democratic Front Party, defeated Banda in a multiparty election.

Banda was born in the Kasungu district of Nyasaland. While in his late teens, he went to study and work in South Africa. He went to the United States in 1923 and graduated from the University of Chicago in 1931. Banda received an M.D. degree from the Meharry Medical College in Nashville in 1937 and then practiced medicine in England and Ghana. In 1958, after living abroad for over 40 years, Banda returned to Nyasaland to lead his country's independence movement. Bruce Fetter

Bandage is any material used to wrap or cover a wound or injured body part. Bandages may be used to hold a dressing for a wound in place. They can also be used to apply pressure to a wound to help control bleeding, to prevent dirt and germs from infecting a wound, and to support injured limbs or body parts.

The most common type of bandage is a commercially manufactured pad of gauze on an adhesive strip. It is available in assorted sizes. Another commercially made bandage, called a *bandage compress,* combines a thick, gauze dressing with a gauze bandage that can be tied in place. It is designed to control bleeding.

A *roller bandage* is usually made of gauze or gauze-like material. It is available in assorted widths and is from 5 to 10 yards (4.6 to 9.1 meters) long. A roller bandage is generally wrapped in place over a dressing. A special roller bandage, called an *elastic bandage,* is made of heavy elastic fibers. It is designed to hold continuous pressure on a body part. When properly applied, it can help to control swelling in the injured area. This bandage is commonly used in athletic settings.

A *triangular bandage* is made by cutting a 40-inch (100-centimeter) square of muslin or similar cloth into two triangular pieces. When folded, the triangular bandage will hold a dressing or a splint in place on nearly any part of the body. It is often used as a sling to support an injured shoulder, arm, or hand.

Critically reviewed by the American Red Cross

See also **First aid; Bleeding.**

Bandaranaike, *bahn drah NEE kee,* **Sirimavo,** *SEE ree MAH vaw* (1916-2000), was prime minister of Sri Lanka (formerly Ceylon) from 1994 to 2000. She also served as prime minister from 1960 to 1965 and from 1970 to 1977. She was the world's first female prime minister. Her husband, S.W.R.D. Bandaranaike, was prime minister from 1956 to 1959. After his assassination in 1959, she became president of his Sri Lanka Freedom Party. Although she had no political experience, she was elected prime minister in 1960.

Robert Cohen, Black Star

Sirimavo Bandaranaike

Mrs. Bandaranaike continued her husband's socialist policies. Her government took over various businesses and had a neutral foreign policy toward Communist and non-Communist countries. Opposition to her economic policies led to her party's defeat in 1965, and she lost her office. Her party won the 1970 election, and she became prime minister again. She served until 1977, when her party was again defeated. In 1988, she ran for president. A 1978 constitutional amendment had made the president, rather than the prime minister, head of the government. Bandaranaike lost the election. Chandrika Bandaranaike Kumaratunga, the daughter of Sirimavo and S.W.R.D. Bandaranaike, was elected president of Sri Lanka in 1994 and reelected in 1999. She appointed Sirimavo Bandaranaike prime minister. Bandaranaike was born in Balangoda in south Ceylon. Robert LaPorte, Jr.

Bandicoot, *BAN duh koot* or *BAN dih koot,* is a small mammal of Australia and New Guinea. Most bandicoots

Hans & Judy Beste, Tom Stack & Associates

The bandicoot is a small ratlike mammal of Australia and New Guinea. Bandicoots have a narrow head and sharp teeth.

weigh less than 2 pounds (0.9 kilogram). Their coarse fur is chiefly brown or gray, and they have a long, narrow head and sharp teeth. The second and third toes of their hind feet are joined.

Most kinds of bandicoots live in forests or other areas of heavy plant growth. Bandicoots dig burrows, or they build nests on the ground, using sticks and leaves. They eat mostly insects, spiders, and worms.

Bandicoots are *marsupials.* Female marsupials give birth to tiny, poorly developed young. Like most marsupials, young bandicoots are carried in a pouch on the mother's belly until they develop more completely. Certain rats of India and Sri Lanka are called bandicoots, but they are not related to the marsupials. Michael L. Augee

Scientific classification. Bandicoots make up the family Peramelidae.

Banding. See **Bird** (Birdbanding).

Bandit is a robber who is usually one of a group of outlaws. The word comes from the Italian word *bandito,* which means *outlaw.* Bandits have always been common in countries where government is weak. In England during the 1100's, Robin Hood was a popular hero of the people against Prince John. In Mexico during the early 1900's, Pancho Villa was sometimes called the champion of the people against the government.

America's most famous bandits lived in the West. The typical bandit was born about 1850, lived only about 35 years, and rarely died a natural death. Such a description would fit Sam Bass, William Quantrill, or Jesse James. Odie B. Faulk

Related articles in *World Book* include:

Bass, Sam	Quantrill, William	Turpin, Dick
Billy the Kid	Rob Roy	Villa, Pancho
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James, Jesse	Robin Hood	
Murieta, Joaquín	Starr, Belle	

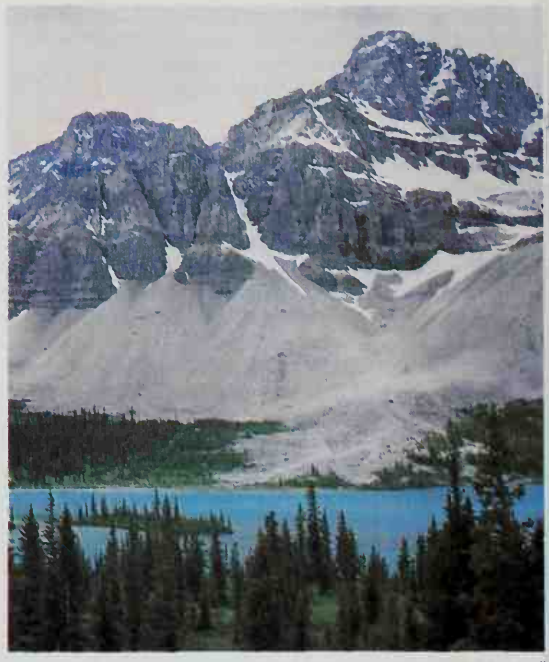
Bandung, *BAHN doong* (pop. 1,401,108), a city on the island of Java, is one of the largest cities in Indonesia. It is 75 miles (121 kilometers) southeast of Jakarta, the capital. For location, see **Indonesia** (map). Bandung is near the equator, but it has a cool climate because it stands 2,430 feet (741 meters) above sea level. Bandung has an aircraft-manufacturing plant. It is also the site of Padjajaran University. Harold Crouch

Banff, *bamf,* Alberta (pop. 7,135), one of the most famous resort towns in Canada, is noted for its natural beauty. The town lies 4,551 feet (1,387 meters) above sea level on the eastern slope of the Canadian Rockies, at the southeastern end of Banff National Park (see **Alberta** [political map]). More than 3 million tourists visit Banff yearly. The Canadian Rockies attract mountain climbers and skiers. Other visitors enjoy golf, fishing, and the famous hot sulfur-water swimming pools. The town was named after Banff, Scotland. David Pommer

Banff National Park, *bamf,* established in 1885 as Hot Springs Reservation, is the oldest national park in Canada. The park's spectacular scenery has made it one of Canada's most popular tourist attractions. The park has many deep valleys, glaciers, lakes, and icecapped mountains. It lies on the eastern side of the Rocky Mountains in southwestern Alberta (see **Alberta** [maps]).

Many features of Banff National Park have been shaped by glaciers during the past million years. Hundreds of glaciers still exist in the mountains. Streams formed by the meltwaters from some of these glaciers feed such lakes as Bow Lake, Lake Louise, Moraine Lake, and Peyto Lake. Banff's deep valleys have dense forests, chiefly of lodgepole pine trees. Subalpine fir, Engelmann spruce, and Lyall's larch grow at higher elevations. Animals in the park include bighorn sheep, black and grizzly bears, deer, elk, moose, and mountain goats.

Visitors can enjoy many outdoor activities. About 970 miles (1,560 kilometers) of trails provide hiking routes. In winter, cross-country skiers use many of the trails. The park also has three downhill skiing areas. Summer visitors may enjoy canoeing and other water sports on the lakes and streams. Near the town of Banff in the southern part of the park is a swimming pool fed by hot mineral springs. The park's 14 campgrounds have about 2,500 campsites. Visitors may also take bus tours of the park and visit a natural history museum.



Ron E. Howell

Banff National Park has spectacular scenery that makes the area one of Canada's most popular tourist attractions.

In 1883, railway workers discovered hot mineral springs in an area near what is now the town of Banff. Several people tried to buy the land and use the springs for private gain. But in 1885, the Canadian government declared 10 square miles (26 square kilometers) around the springs to be a public land reserve. This action, in effect, established the land as a national park. In 1887, the government expanded the reserve to 210 square miles (544 square kilometers) and officially declared it a national park. The park's name was changed to Banff National Park in 1930. Today, the park covers more than 2,500 square miles (6,470 square kilometers).

Critically reviewed by Banff National Park

See also **Alberta** (picture); **Banff; Lake Louise; National park** (picture).

Bangalore, *bang guh LOHR* (pop. 4,292,223; met. area pop. 5,686,844), is the capital and largest city of Karnataka, a state in southern India. The city serves as the commercial, industrial, and educational center of Karnataka. See also **India** ([political map]; pictures).

Bangalore was founded in 1537 by Kempe Gowda, a local chief. The commercial hub of the city is the old section, called Petta, where markets sell fruits, vegetables, and other products. The city is the home of Bangalore University and several major institutes of scientific research. Bangalore's metropolitan area greatly expanded during the 1900's as the result of the establishment of new industrial suburban communities. Products of these communities included aircraft, machine tools, telephones, and textiles. Riffat Sardar

Bangkok, *BANG kahk* (pop. 5,876,000), is the capital and largest city of Thailand. It is the nation's primary commercial, cultural, and industrial center. The largest part of Bangkok lies on the east bank of the Chao Phraya

River, about 17 miles (27 kilometers) north of the Gulf of Thailand. Bangkok also includes an area on the west bank, which was formerly a separate city called Thon Buri. For location, see **Thailand** (map). The Thai name for Bangkok is *Krung Thep,* which means *City of Angels* or *Heavenly City.*

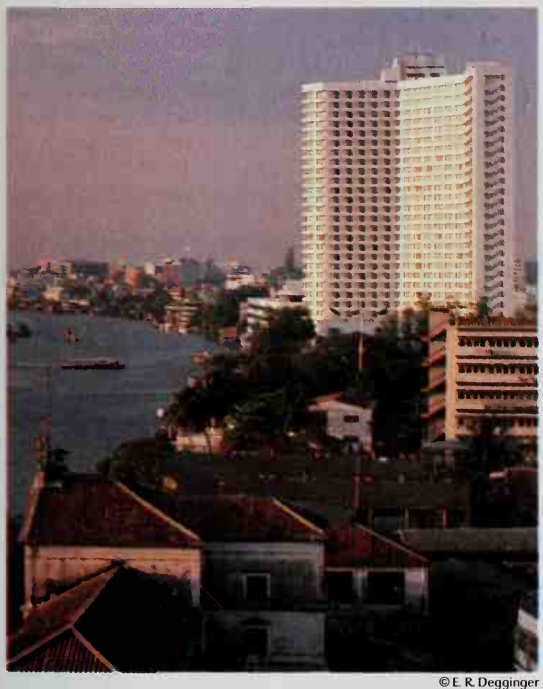
The city is a sprawling, fast-growing metropolis. Bangkok was once called the "Venice of the East" because it had so many canals. Most of the canals have been filled in and replaced by streets and expressways, though there are still some canals west of the Chao Phraya River.

Bangkok has long been famous for its magnificent temples and palaces. The finest of these structures are in the city's historic center near the river. The Grand Palace, once the home of the Thai kings and now used for state ceremonies, overlooks the river. The royal family lives in the Chitlada Palace, about 1 $\frac{1}{2}$ miles (2.4 kilometers) northeast of the Grand Palace. The area between the two palaces is the city's chief government and cultural center. It includes the major Thai government buildings and the national library, museum, and theater. Bangkok has more than 300 Buddhist temples, also called *wats.* One of the most impressive is the Temple of the Emerald Buddha on the grounds of the Grand Palace.

Houses, shops, and small industries stand together in new and old structures throughout Bangkok. Traditional *shophouses* line many streets, with stores on the first floor and housing on upper floors. Commercial districts range from outdoor markets to modern shopping malls. On weekends, shoppers flock to Chatuchak, one of the largest outdoor markets in the world. Other city buildings include hotels, office buildings, nightclubs, and movie theaters.

James Holland, Stock, Boston

The Temple of the Emerald Buddha is one of the many colorful buildings in Bangkok. Most of these buildings date back to the late 1700's and the 1800's.



© E. R. Degginger

Bangkok, the capital of Thailand, lies along the Chao Phraya River. The city is Thailand's chief port and the center of the nation's commerce and industry.

Bangkok faces many problems. About a sixth of the city's housing consists of slums. The city suffers from inadequate garbage collection, especially in the slums. Severe traffic jams occur regularly, causing hazardous levels of air pollution. In addition, floods often damage the city during the rainy season, from July to December. Flooding problems have worsened because the land on which Bangkok stands has been sinking 2 to 4 inches (5 to 10 centimeters) a year since the early 1960's.

Despite Bangkok's modern features, the city maintains a distinctively Thai character. Sidewalk vendors are common, and there are outdoor eating areas throughout the city. The people of Bangkok still practice traditional Thai styles of dance, music, and handicrafts.

Economy of Bangkok is based on trade, tourism, and government service. The city is Thailand's chief port and the center of its railroad and canal network. The nation's main international airport is nearby. Many local and foreign firms operate factories in the Bangkok metropolitan area. Products manufactured in these factories are exported throughout the world.

History. Bangkok was a small village until 1782, when King Rama I made it a royal city. According to Thai belief, the king's palace was the "center of the universe." The city was laid out to reflect this idea. The Grand Palace was built first. Major temples and government buildings were built nearby. Less important buildings went up in areas farther from the palace.

Bangkok grew through the years, but the city's most dramatic growth occurred in the late-1900's. The population of the city tripled between 1960 and 2000.

Amrita G. Daniere

Mireille Vautier, A.A.A. photo

Rural villages lie throughout the countryside of Bangladesh. A large majority of the nation's people live in rural areas. Boats provide their chief means of transportation. The boats travel along a network of waterways that flow through almost all parts of the country.

Bangladesh

Bangladesh, *BAHNG gluh DEHSH* or *BANG gluh DEHSH,* is a South Asian nation that once formed part of Pakistan. Bangladesh gained independence in 1971 after a nine-month civil war between East Pakistan and West Pakistan. From 1947 to 1971, the region that is now Bangladesh was East Pakistan. More than half the people of Pakistan lived there.

The northeast part of India borders Bangladesh on three sides. Bangladesh shares many cultural and geographical features with nearby West Bengal, which is a state of India. Bangladesh and West Bengal form a region that is known as *Bengal.* Bangladesh is sometimes called *East Bengal.* The name *Bangladesh* means *Bengal nation.*

Bangladesh is one of the world's most densely populated countries. The nation's rapid population growth has led to serious overcrowding. The people of Bangladesh are called *Bangladeshis.* Dhaka, formerly spelled Dacca, is the capital and largest city of Bangladesh.

Widespread poverty has long characterized the region. Most Bangladeshis are poor farmers who struggle to make a living on small plots of land. Many laborers in the cities work for about a dollar a day. Most of Bangladesh's adults cannot read or write. About 85 percent of the country's people are Muslims, and most of the rest are Hindus.

Plant life thrives in the warm, humid climate of Bangladesh. Most of the country's land consists of a flat, fertile flood plain, and is crisscrossed by innumerable rivers and streams. The rivers deposit fertile soil along their banks during periodic floods. However, many of the floods also cause widespread destruction in Bangladesh's rural villages.

The region that now makes up Bangladesh has been governed by Hindu, Muslim, and Buddhist rulers at various times in its history. The British East India company became the leading power in the area in 1757. The region became part of the British Empire when Britain took control of India in 1858.

Bloody conflicts that occurred between Hindus and Muslims led to the division of India into two nations in 1947, when India gained independence. Pakistan—consisting of East Pakistan and West Pakistan—was created out of the northeastern and northwestern parts of India. The majority of the people living in both areas were Muslims.

Numerous differences, both cultural and economic, divided the peoples of East Pakistan and West Pakistan. In 1971, civil war led to the establishment of East Pakistan as an independent country—Bangladesh. For more detailed information on the events leading up to the creation of Bangladesh, see the *History* section of this article.

The contributor of this article is Myron Weiner, Ford International Professor of Political Science at Massachusetts Institute of Technology.

National government. Bangladesh has a parliamentary system of government. A prime minister is the head of government and is chosen from the political party that wins the most seats in Parliament. Cabinet members are appointed by the prime minister to head departments that carry out the functions of the government. A president serves as head of state. The position of president is mainly ceremonial. The president is elected by Parliament to a five-year term.

The Parliament makes the country's laws. It has 330 members. The people elect 300 of the members to five-year terms. The 30 other seats in Parliament are reserved for women, who are chosen by the elected members of Parliament for five-year terms.

Local government. Villages are the smallest units of local government in Bangladesh. Villages are grouped together to form *unions*. These unions, in turn, form administrative units that are called *thanas*. A group of thanas forms a *zilla* (district), the largest unit of local government in Bangladesh. Governing councils at each level of local government consist of officials who are elected by the people.

Political parties. Bangladesh has many political parties. The three most important parties are the Bangladesh Nationalist Party (BNP), the Jatiya Dal (National Party), and the Awami League. The Awami League gained control of Parliament after elections in June 1996. The BNP had held a majority of seats in Parliament before the June 1996 elections.

The Awami League led the fight for independence in Bangladesh. The league supports many socialist economic policies. The BNP and the Jatiya Dal parties have similar platforms. Both of them favor a free enterprise economic system.

Armed forces. During the civil war of 1971, a guerrilla resistance army called the *Mukti Bahini* (Freedom Force) was formed in what was then East Pakistan. After the war, members of the Mukti Bahini became part of the regular army, navy, and air force of Bangladesh. The country also has a militia.

© Sandro Tucci, Gamma/Liaison

The National Parliament Building in Dhaka, the capital of Bangladesh, was completed in the early 1980's. It is part of a complex of government buildings.

The Bangladesh flag was officially adopted in 1972. The red stands for the sun and the green for scenic beauty.

National emblem. A water lily, the national flower of Bangladesh, appears in the center of the emblem.

Facts in brief

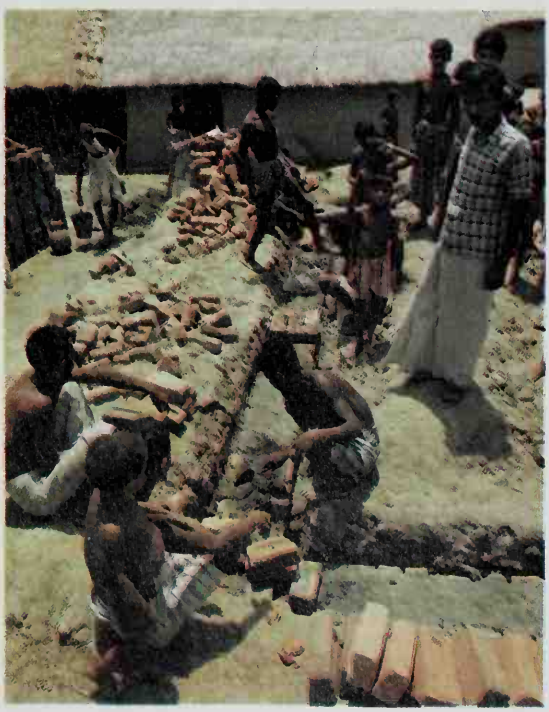
Capital: Dhaka.
Official language: Bengali.
Official name: People's Republic of Bangladesh.
Head of government: President.
Area: 55,598 mi² (143,998 km²). *Greatest distances*—north-south, 464 mi (747 km); east-west, 288 mi (463 km). *Coastline*—357 mi (575 km).
Elevation: *Highest*—Mount Keokradong, 4,034 ft (1,230 m) above sea level. *Lowest*—sea level.
Population: *Estimated 2002 population*—133,557,000; density, 2,402 per mi² (927 per km²); distribution, 80 percent rural, 20 percent urban. *1991 census*—111,455,185.
Chief products: *Agriculture*—jute, rice, sugar cane, tea, tobacco, wheat. *Manufacturing*—jute products, leather, paper and paper products, textiles. *Mining*—natural gas.
National anthem: "Amar Sonar Bangla" ("My Golden Bengal").
National holidays: Shaheed Dibash (Martyrs' Day), February 21; Independence Day, March 26; Victory Day, December 16.
Money: *Basic unit*—taka. One hundred poisha equal one taka.

WORLD BOOK map

Bangladesh lies in southern Asia, north of the Bay of Bengal. It is bordered by India and Myanmar.

J. Alex Langley, DPI

Traffic jams occur frequently in the cities of Bangladesh. Bangladesh is one of the world's most densely populated countries, and overcrowding is a problem in both urban and rural areas.



Herta Newton, Van Cleve Photography

Rural villagers live in simple one- or two-room homes with thatched roofs. The Bangladeshis shown above are building a brick home, but many rural dwellings are made of bamboo.

Population and ancestry. Bangladesh is one of the largest countries in the world in population. Bangladesh is also one of the world's most densely populated countries.

Most of the people of Bangladesh are probably descendants of peoples who migrated to the area thousands of years ago from what are now Burma, Tibet, and northern India. The term *Bangladeshis* refers to all the people of Bangladesh. More than 95 percent of Bangladesh's population are *Bengalis,* a short, dark-skinned people. They speak a language also called Bengali.

Bangladesh also has several minority groups. They include various ethnic groups that live mainly in the Chattagram Hills of southeastern Bangladesh. The largest groups include the Chakmas, the Marmas, the Mros, and the Tipperas.

Way of life. Most Bangladeshis farm the land with simple tools and ancient methods, much as their ancestors did many years ago. Since the mid-1970's, however, there has been increasing use of fertilizers and new kinds of seeds.

Clusters of thatch-roofed houses dot the nation's countryside. Most rural villagers build homes made of bamboo. A typical home consists of only one or two rooms. Few homes in rural areas have electricity or plumbing.

Most of the families in the cities and towns live crowded together in small wooden houses. Some wealthy city families have large brick or concrete homes. In urban slums, the houses are built of cardboard, scraps of wood, or sticks. The majority of Hindus and

members of other minority groups live together in distinct neighborhoods.

Many of the people of Bangladesh do not have enough food to eat. Although food production has increased since the mid-1970's, the nation neither raises nor imports enough to feed its large population. Few Bangladeshis have much variety in their meals. Rice and fish are the two most important foods. They are usually served together in a spicy curry sauce. Tea sweetened with sugar is a popular beverage, though some people may drink only water most of the time.

People throughout Bangladesh wear loose, lightweight clothing because of the warm, humid climate. Most of the women wear a *sari,* a long piece of plain or printed cloth wrapped around the waist and draped over one shoulder. A short blouse is worn underneath. Many Muslim men wear a *lungi,* a tight skirtlike garment. The *dhoti,* worn by Hindu men, is a piece of cloth

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*Does not appear on map; key shows general location.
†1991 census.
Source: 1981 census except where indicated by †.

Shoppers and vendors gather at open-air marketplaces, such as this one in Dhaka. In many families, the men do most of the shopping, and the women stay home doing household chores.

Alan Band Associates

wrapped around the waist and between the legs. Men may also wear shirts. People of rural areas generally go barefoot. City dwellers may wear shoes or sandals.

Bangladeshis like to spend their leisure time chatting with friends and relatives. The men usually gather in cafes, and the women visit one another at home. The people enjoy the festivities held during various Muslim and Hindu religious holidays.

Religion affects much in the lives of most Bangladeshis, including food, marriage customs, and family relationships. About 85 percent of the people are Muslims. The laws of Islam, the Muslim religion, forbid the eating of pork. Most Muslim parents arrange marriages for their children. A Muslim man may have up to four wives at a time. However, most Muslim men in Bangladesh are too poor to have more than one. The men in a Muslim family have far more authority and freedom than the women have. Many Muslim women avoid social contact with men who do not belong to their family, and they participate in few activities outside the home. They cover their heads with veils in the presence of strangers. In 1988, a constitutional amendment made Islam the state religion of Bangladesh. See **Islam**.

Less than 15 percent of the people of Bangladesh are Hindus. Hindus are divided into various social classes called *castes*. Each caste observes its own customs and rules of behavior. Caste regulations limit the extent to which members of one caste may associate with members of another caste. Hindu parents also arrange their children's marriages. Intermarriage between castes is rare. Hindu women have more social freedom than Muslim women do, though Hindu women have few legal rights. See **Hinduism; Caste**.

Most of the ethnic groups of the Chattagram Hills area practice Buddhism. Some groups combine Buddhist principles with local religious beliefs. Less than 1 percent of the people of Bangladesh are Christians.

Education. Most Bangladeshis 15 years of age or older cannot read or write. For Bangladesh's literacy rate, see **Literacy** (table: Literacy rates for selected countries). A law requires children from ages 6 to 10 to attend school. But the law is not strictly enforced, and many youngsters do not attend school.

The University of Dhaka is the nation's largest university. Dhaka is also the home of the Jahangirnagar Muslim University and the Bangladesh University of Engineering and Technology. Other universities are in Chattagram, Mymensingh, and Rajshahi.

Health. Food shortages and unsanitary living conditions in Bangladesh contribute to widespread cholera, leprosy, tuberculosis, and other diseases. Mosquitoes that spread malaria thrive in the nation's swampy regions. Malaria kills thousands of Bangladeshis annually.

Bangladesh has a serious shortage of doctors, nurses, hospitals, and medical supplies. The Red Cross and other organizations have sent medical teams and equipment in an attempt to improve health conditions.

The arts. Bengali literature has flourished for hundreds of years in the form of stories and folk ballads. These stories and ballads tell romantic legends and tales of everyday life. Dramas based on religious stories are popular forms of entertainment in Bangladesh. Rabindranath Tagore, a Bengali poet born in India, became prominent in Bengali literature during the late 1800's. He still ranks as the most popular literary figure in Bangladesh. See **Tagore, Rabindranath**.

Much of the traditional architecture of Bangladesh developed under Muslim rule during the 1500's and 1600's. This style features domes, towers, and pointed arches. Traditional painting has the brilliant colors and elaborate decorations of Muslim religious art. Some contemporary artists of Bangladesh use techniques of modern Western art in painting everyday scenes and people, as well as in abstract designs.

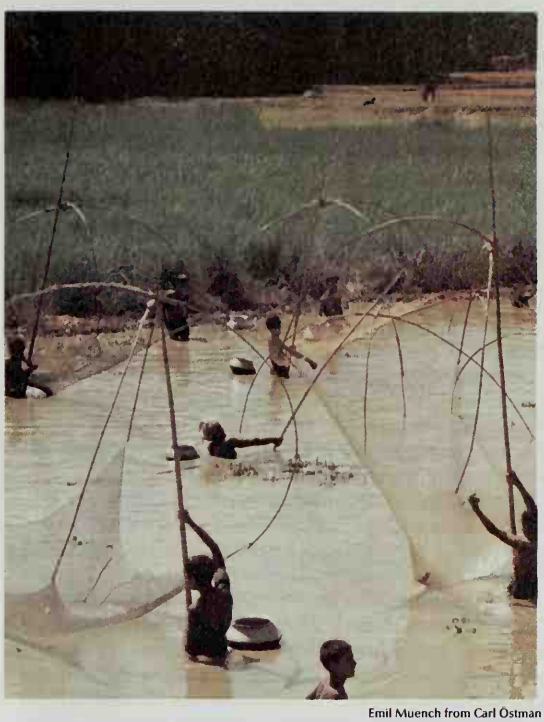
Almost all of Bangladesh consists of a flat, low-lying *alluvial plain* (land formed from soil deposited by rivers). Most of the country lies less than 50 feet (15 meters) above sea level. The far northeast and southeast corners of Bangladesh have many hills. Mount Keokradong, the country's highest peak, rises 4,034 feet (1,230 meters) above sea level in the Chattagram Hills area in the southeast.

Rivers and streams. Three major rivers—the Brahmaputra, the Ganges, and the Meghna—flow through the flat plains that cover most of Bangladesh. These rivers and their branches overflow during the rainy season and deposit fertile soil along their banks. The soil deposits that have built up at the mouths of the rivers form the broad Ganges Delta. Rice and jute, the most important crops of Bangladesh, thrive in the wet delta region.

Many small streams and canals also crisscross the country. Boats can reach almost every part of the Bangladesh interior.

Coastline of Bangladesh extends 357 miles (575 kilometers) along the Bay of Bengal. Deep inlets mark the jagged coastline of the country, and small islands dot the offshore delta area.

Forests. Bamboo and such trees as mango, palm, and tamarind grow throughout most of Bangladesh. But the most valuable forest resources are in the Chattagram Hills in southeastern Bangladesh, and in the Sundarbans in the southwest. Teak is an important product of the Chattagram Hills forests. The Sundarbans is a swampy region covered by mangrove trees and other tropical plants. Bengal tigers live in this area.



Emil Muench from Carl Ostman

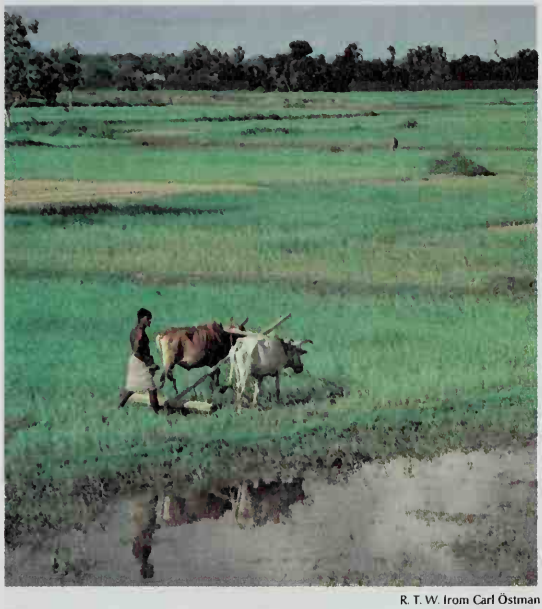
Countless rivers and streams flow through Bangladesh. The inland waterways provide an important source of fish, and they also serve as the country's chief transportation routes.

Climate

Bangladesh is generally warm and humid throughout the year. The temperature varies little from one part of the country to another, though the north may be slightly cooler than the south in winter. Temperatures in Bangladesh average about 82 °F (28 °C) in April, the hottest month in most parts of the country. January, the coldest month in Bangladesh, has an average temperature of 64 °F (18 °C).

Bangladesh receives ample rain. The eastern part of the country has an average annual rainfall of about 100 inches (250 centimeters) and the west has an average of about 65 inches (165 centimeters). The far northeastern region gets the most rain—as much as 250 inches (635 centimeters) a year. In most years, the rainy season in Bangladesh lasts from mid-March to the end of October. Afternoon thunderstorms occur frequently from mid-March to mid-May. The heaviest rain comes during the monsoon season, from mid-May to October. Many of the monsoon rains cause the rivers to overflow and flood the surrounding countryside.

Cyclones often strike Bangladesh at the end of the monsoon season. These violent storms may be accompanied by huge destructive waves called *tsunamis* that rise from the Bay of Bengal and sweep across the low-lying countryside. Some of the most severe cyclones and tsunamis have destroyed towns and villages and killed thousands of people.



R. T. W. from Carl Östman

The warm, humid climate of Bangladesh is ideal for growing rice and other crops. Heavy rains water the flat, fertile plains that cover most of the country.

Bangladesh ranks as one of the poorest nations of the world. It has an average annual *per capita* (per person) income of about $200 a year.

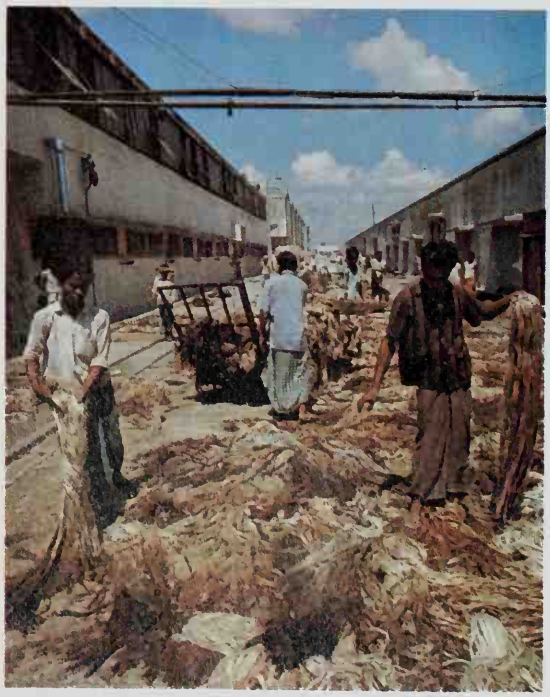
Bangladesh has a developing economy. The country depends heavily on agriculture. It has few natural resources. However, industry is growing rapidly in the country, especially the manufacture of clothing and textiles.

The civil war of 1971 caused a serious breakdown of the economy. Farming activities were interrupted as millions of people fled their homes to escape the fighting. Factories and shops were destroyed, and transportation and communication lines were damaged. Shortly after Bangladesh became independent, the government took control of the chief businesses and industries. Many of these establishments had been owned by West Pakistanis before the civil war.

Natural resources. Fertile soil is probably the chief natural resource of Bangladesh. Farmers in almost all parts of the country grow jute, rice, sugar cane, tobacco, and wheat in the rich, wet soil.

Much natural gas and some petroleum have been discovered in Bangladesh. The country also has small deposits of coal, limestone, and peat.

Agriculture is by far the most important economic activity in Bangladesh. About two-thirds of the people farm the land. Even so, Bangladesh does not produce enough food for its large population. One main reason is that most farmers in Bangladesh use outdated tools and methods. The nation's farms cover an average of only about $3\frac{1}{2}$ acres (1.4 hectares).



J. Alex Langley, DPI

The processing of jute is an important industry of Bangladesh. Workers in a jute mill spread the plant fibers outdoors to dry before spinning them into string or rope.

Rice, the chief crop, grows in almost all parts of Bangladesh. Farmers harvest three crops of rice in most years. Bangladesh ranks among the world's leading rice-growing countries. Jute, a plant whose fibers are made into string or woven into cloth, is Bangladesh's chief export crop. Bangladesh produces more jute than any other country. Wheat is another major crop in Bangladesh. Farmers also grow sugar cane, tea, and tobacco.

Many farmers in Bangladesh raise livestock. Most of the animals are undernourished, and the cattle do not produce much milk. But the large number of livestock make Bangladesh a leading supplier of animal hides and skins.

Manufacturing. Many modern factories in Bangladesh make clothing, the country's leading manufactured product. Other factories produce agricultural equipment, leather goods, matches, paper, and textiles. Many factories process jute by spinning the raw fibers into string and rope, which may then be woven into burlap or other materials. Bangladesh is too poor to import large quantities of raw materials.

Many Bangladeshis work in their homes making items that are sold in shops or exported. Some craftworkers weave cotton, jute, or silk into cloth. Others make embroidered items, leather goods, pottery, and woodenware. Still others make articles of brass, copper, gold, or silver.

Fishing industry. Fish thrive in the many inland waterways of Bangladesh and in the coastal waters of the Bay of Bengal. The people catch large quantities of fish for their own use and for export.

Foreign trade. Clothing is the main export of Bangladesh. It accounts for more than half of the country's export income. Bangladesh also exports fish, jute, leather, and tea. Leading imports of Bangladesh include building materials, chemicals, coal, electric appliances, food and food products, machinery, petroleum, textiles, and transportation equipment.

Transportation. Waterways serve as the chief transportation routes in Bangladesh. The country has about 4,500 miles (7,200 kilometers) of navigable waterways. Passenger and cargo ships make regular trips on the major rivers between the largest cities and towns. The people also use canoes and small wooden boats for transportation. Chattagram is the nation's chief seaport. Major river ports include Barisal, Chalna Port, Chandpur, Dhaka, and Narayanganj.

Roadbuilding is difficult and expensive in Bangladesh because of the need to construct bridges across the country's numerous rivers and streams. Many of the country's roads and railroads become unusable during the monsoon season, when heavy flooding occurs. Bangladesh has about 3,600 miles (5,800 kilometers) of paved roads and approximately 1,800 miles (2,900 kilometers) of railroad track. An international airport handles flights to and from Dhaka.

Communication. Bangladesh has both Bengali and English-language newspapers. The government owns the nation's nine radio stations and one television station, and the telegraph and telephone systems. Few homes in rural areas have telephones or radios. Villagers may gather in cafes or other public places to listen to radio broadcasts. Only a small number of families can afford a TV set.

Early history. Ancient Hindu epics indicate that thousands of years ago, tribal people inhabited a kingdom called Vanga in the region that is now Bangladesh. Historians know little about the region before about the 200's B.C., when it formed part of the Mauryan Empire. This empire broke up about 185 B.C., and local kings then ruled Bengal. From about A.D. 320 to 500, the region was part of the Gupta Empire. See **Mauryan Empire; Gupta dynasty.**

Buddhist rulers gained control of eastern Bengal in the mid-700's. Buddhist culture spread throughout the region. After about 300 years of Buddhist rule, Hindu kings came to power. Beginning in the 1200's, Turkish Muslims who had conquered northern India extended their control into eastern Bengal. Independent Muslim rulers governed parts of Bengal until 1576, when the Mughal emperor Akbar conquered the region.

Mughal rule. Bengal became part of the Mughal Empire, which spread across most of what is now Afghanistan, India, and Pakistan. Muslim art and architecture flourished under Mughal rule. By about the 1600's, most of the people of eastern Bengal had converted to Islam.

The Mughal emperors appointed governors called *nawabs* to rule the provinces of the empire. In the early 1700's, the empire began to break up, partly because powerful Hindu groups in central and western India rebelled against Muslim rule. At the same time, Bengal and other provinces became increasingly independent as the nawabs took more power for themselves.

The growth of European influence. During the 1500's, British, Dutch, French, and Portuguese traders competed for control of the profitable trade between the East Indies and Europe. By the 1600's, European trade settlements had been established in Bengal. At first, the Europeans met strong resistance from the provincial nawabs, who demanded taxes in return for trade privileges. But after the Mughal Empire began to weaken in the 1700's, the Europeans increased their influence. Ambitious Mughal nawabs, nobles, and generals competed for power. The Europeans took sides in many of these conflicts, offering their support in return for monopoly trade privileges and other rewards.

The East India Company was chartered by the English government in 1600 to develop trade with India and the Far East. By the mid-1700's, the company had become the strongest trade power in Bengal. In 1757, company forces led by Robert Clive defeated the nawab of Bengal in the Battle of Plassey. Clive put a puppet nawab in office, but the East India Company actually ruled Bengal. See **East India Company.**

Corrupt company officials made huge profits on jute production in eastern Bengal, but they did little to improve the welfare of the people. Opposition to the company spread, not only in Bengal, but also in other areas of India that the firm controlled. The discontent led to the Indian Rebellion in 1857. The revolt failed, but it caused the British government to take over the company in 1858. All the Indian territory that the firm had governed became known as *British India.*

British India. Bengal became a province of British India. Under British rule, industrial development and educational reforms advanced rapidly in western Bengal, where most of the people were Hindus. Many Hindus gained economic and political power. But eastern Bengal, where most people were Muslims, remained backward and agricultural. In 1905, the *viceroy* (governor) of British India divided Bengal into two sections—West Bengal and East Bengal. East Bengal became part of a new province. Many Hindu Bengalis objected to the division. They feared a loss of their economic and political power. But Muslims favored the division because they made up the majority of the province's population. The conflict led to bloody rioting between Hindus and Muslims in Bengal. The British reversed the division in 1911, and Bengal again became a single province. But the bitterness between Hindus and Muslims remained.

Throughout British India, independence movements began to gain strength in the 1900's. The Muslim League, a political organization formed in 1906, became the voice of India's Muslim minority. By 1940, league leaders were demanding that a Muslim nation—to be called *Pakistan*—be created out of Indian territory. Riots between Hindus and Muslims in the 1940's convinced government leaders that India would have to be divided. In 1947, Britain granted independence to India and established Pakistan as an independent nation. The British divided Bengal between the two countries. Western Bengal became a state of India. Eastern Bengal became East Pakistan. See **Pakistan** (History).

East Pakistan was separated from West Pakistan by about 1,000 miles (1,600 kilometers) of Indian territory. The people of the two parts of Pakistan shared a common religion, but they had little else in common. They spoke different languages and had different cultures, traditions, and physical traits. East Pakistanis made up more than half the population of Pakistan, but West Pakistanis controlled the nation's government, economy, and armed forces. Only about a fourth of the money spent by the government went to East Pakistan. The per capita annual income of East Pakistan was less than three-fifths that of West Pakistan.

Through the years, East Pakistanis grew increasingly dissatisfied with the government of Pakistan. In November 1970, a cyclone and tsunami struck East Pakistan and killed about 266,000 people. Many East Pakistanis accused the government of delaying shipments of relief supplies to the devastated areas.

In December 1970, elections were held throughout Pakistan to choose an assembly that would serve as a legislature and write a new constitution. The Awami League, a party led by East Pakistan's Sheik Mujibur Rahman (known as Sheik Mujib), won a majority of the seats. The party strongly supported increased self-government for East Pakistan.

On March 1, 1971, President Yahya Khan of Pakistan postponed the first meeting of the assembly. East Pakistanis protested, and Yahya Khan sent army troops to East Pakistan to put down the protests. Sheik Mujib was imprisoned in West Pakistan.

Civil war soon broke out. The fighting began in East Pakistan. Then, on March 26, 1971, the East Pakistanis declared East Pakistan an independent nation called Bangladesh. They formed a guerrilla army to fight the government troops. Thousands of civilians died in the bloody fighting that followed, and millions of refugees poured into India.

During the early months of the civil war, East Pakistani guerrillas also crossed into India. The government

© Baldev, Sygma

A cyclone and tsunami, a huge, destructive wave, struck Bangladesh in 1991. About 138,000 people died in the disaster, which caused billions of dollars in damage. Cyclones often strike Bangladesh. These violent storms may be accompanied by tsunamis that sweep across the countryside.

forces shelled Indian territory and followed the guerrillas across the border. Indian troops fought border clashes with the Pakistani government soldiers. In December 1971, the Indian Army advanced into East Pakistan and joined the guerrillas. The combined forces of the Indians and guerrillas overpowered West Pakistan, which surrendered on Dec. 16, 1971.

The new nation. Sheik Mujib was released from prison in January 1972. He returned to Bangladesh in triumph and became the nation's first prime minister.

Bangladesh faced staggering problems as an independent country. Millions of its people were homeless. Trade, transportation routes, and communication lines had to be restored. Hospitals, factories, and schools had to be rebuilt. Reconstruction began quickly. But floods and food shortages caused much suffering, and charges of corruption weakened the government.

In January 1975, Bangladesh amended its Constitution to give the president all executive power. Mujib resigned as prime minister and took office as president. He soon suspended all opposition political parties and declared Bangladesh a one-party state. In August 1975, military leaders killed Mujib. They dissolved the Parliament, took control of the government, and began to rule under martial law. Ziaur Rahman (known as Zia), an army officer, became head of the martial law government in November. He took the title of president in 1977. In 1978, the people elected Zia president. In 1979, Zia became head of the Bangladesh Nationalist Party (BNP), which had formed after the 1978 elections.

In 1979, the military leaders ended martial law, and the people elected a new Parliament. Zia remained president. In 1981, rebels led by a military officer killed Zia. Vice President Abdus Sattar was elected president later that year. In 1982, military leaders again took control of the government. Lieutenant General H. M. Ershad suspended the Constitution and established martial law. From 1982 to 1984, Ershad banned the activity of political parties. He took the title of president in 1983.

In May 1986, Ershad allowed the first parliamentary elections in Bangladesh since 1979. In August, Ershad resigned from the army in order to run as a civilian candidate for president. He became head of the Jatiya Dal, a party formed by his supporters. In November 1986, the people elected him president. Soon after, the Parliament passed a law protecting Ershad from prosecution for actions taken during the period of martial law. He then ended martial law and restored the Constitution.

In late 1990, thousands of people held violent protests against Ershad's government. Ershad resigned as president in December. He was later tried and convicted of abuse of power, corruption, and other charges.

Elections were held in February 1991. The BNP gained control of Parliament, and its leader, Khaleda Zia, became prime minister. Zia, the widow of President Zia, was the first woman prime minister of Bangladesh. In September 1991, Bangladesh amended its Constitution and returned executive power to the prime minister. The position of president became mainly ceremonial.

Recent developments. The BNP won parliamentary elections held in February 1996. But the elections were marred by charges of election fraud, violence at the polls, and low voter turnout. The country held elections again in June 1996. In that vote, the Awami League won the most seats in Parliament, and its leader, Sheikh Hasina Wajed, became prime minister. Wajed is the daughter of the country's first prime minister, Sheik Mujib.

Parliamentary elections in 2001 returned the BNP to power. Khaleda Zia again became prime minister.

Myron Weiner

Study aids

Related articles in *World Book* include:

Bay of Bengal	Dhaka	Jute
Bengal	Ganges River	Mujibur Rahman
Brahmaputra River	Islam	Muslims

Outline

I. **Government**
II. **People**
  A. Population and ancestry
  B. Way of life
  C. Religion
  D. Education
  E. Health
  F. The arts
III. **The land**
  A. Rivers and streams
  B. Coastline
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IV. **Climate**
V. **Economy**
  A. Natural resources
  B. Agriculture
  C. Manufacturing
  D. Fishing industry
  E. Foreign trade
  F. Transportation
  G. Communication
VI. **History**

Questions

What does the name *Bangladesh* mean?
Who was Rabindranath Tagore?
What is a *sari?* A *lungi?*
When did the East India Company gain control of Bengal?
What are the country's chief agricultural products?
What country borders Bangladesh on three sides?
What three major rivers flow through Bangladesh?
What percentage of the country's people live in cities?
What is the Sundarbans?
What is the country's chief natural resource?

Bangor, *BANG gawr* (pop. 31,473; met. area pop. 90,864), is the gateway to the hunting and fishing country of northern and eastern Maine. It lies in south-central Maine on the Penobscot River, near the Atlantic Ocean (see **Maine** [political map]). It is a regional center for services, trade, distribution, and precision manufacturing. Bangor's products include electronic components, lumber machinery, metal products, and paper products. The city has an international airport. It is the home of Bangor Theological Seminary and Husson College. The University of Maine's Orono campus is north of Bangor.

Settlement of Bangor began in 1769. It was incorporated as a town in 1791 and as a city in 1834. Bangor became a great lumber port about 1870. But shipping declined with the coming of the railroads. Bangor is the seat of Penobscot County. Jeffrey Strout

Bangui, *bahng GEE* (pop. 473,817), is the capital and largest city of the Central African Republic. Bangui lies in the southwestern part of the country, on the Ubangi River. For its location, see **Central African Republic** (map).

Bangui is the commercial center of the Central African Republic. Most of the country's exports are shipped from the city's port on the Ubangi. Bangui's business district has many new apartment and office buildings. Most of the people live in modern housing.

Bangui was founded by the French in 1889. The city became part of the newly established French territory of Ubangi-Shari in 1894. In 1958, the territory achieved limited self-government and was named the Central African Republic. The republic gained full independence from France in 1960. Immanuel Wallerstein

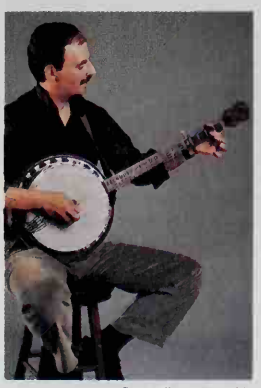
See also **Central African Republic** (picture: Bangui).

Bangweulu, Lake. See **Lake Bangweulu.**

Banian. See **Banyan tree.**

Banjarmasin, *BAHN juhr MAH sihn,* also spelled *Bandjarmasin* (pop. 436,212), is the capital of South Kalimantan province in Indonesia. The city lies on the Barito River in southeastern Borneo (see **Indonesia** [map]). Banjarmasin exports oil, timber, copra, and diamonds. It was founded by the Dutch in 1711. In 1942, during World War II, Japanese forces seized the city. The Allies recaptured it in 1945. Colin MacAndrews

Banjo is a stringed musical instrument that has a round metal or wooden body and a long *fretted* (ridged) neck. The body is actually a small drum with a tightly stretched skin, called a *head,* on one side. Most banjos have five strings. These strings extend from the *pegbox,* at the top of the neck, to the *tailpiece,* on the far side of the head. The strings are supported by a low, flat *bridge* on the head. The player plucks the strings with the thumb and fingers of the right hand or with a *plectrum* (pick). The fingers of the left hand press down on the strings along the neck to create different notes.



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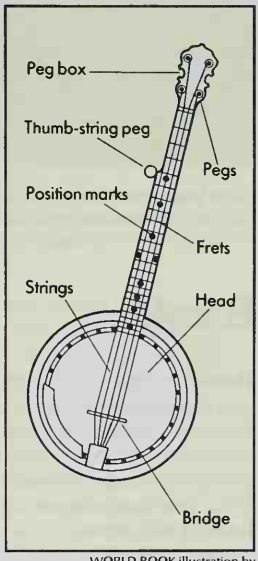


WORLD BOOK illustration by Oxford Illustrators Limited

The banjo is a stringed musical instrument played with the fingers or with a pick called a *plectrum.* The banjo is used primarily to play folk music and country music.

The banjo may have originated in Africa or Asia. Black slaves from western Africa brought the instrument to the Western Hemisphere. During the early 1900's, the banjo was used as a rhythm instrument in jazz bands. Today, it is used primarily to play folk and country music. Abram Loft

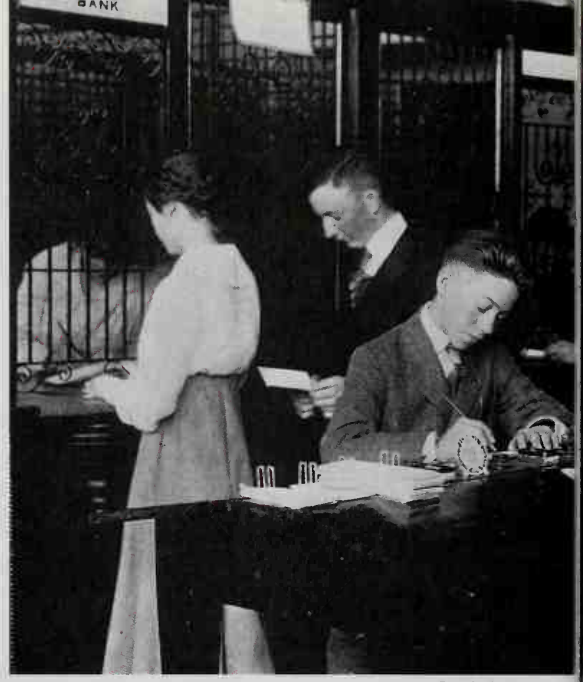
Banjul, *BAHN jool* (pop. 44,188), is the capital and the largest city of Gambia. It lies at the mouth of the Gambia River on St. Mary's Island, along the west coast of Africa (see **Gambia** [map]). A bridge connects Banjul with the mainland.

Banjul is Gambia's chief port. Peanuts are the port's main export. Most of Gambia's manufacturing takes place in the Banjul area. The area has factories for processing peanuts, producing beverages and clothing, and assembling farm machinery.

The British founded the city in 1816 and called it Bathurst. The city began as a base for British efforts to stop the slave trade in Africa. It soon became a general trade center. The British administered the city as part of a colony they had established in Gambia until Gambia gained independence in 1965. The city was renamed Banjul in 1973. Lansiné Kaba

Biblioteca Estense, Modena, Italy (Scala/Art Resource)

Early bankers in Italy, where the development of modern banking began, conducted their business on benches in the street. This painting shows an Italian bank of the 1400's.



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Banking in the United States changed dramatically in the late 1800's with the introduction of a new national banking system. This photograph shows an American bank around 1910.

Bank

Bank is a financial firm that accepts people's deposits and uses them to make loans and investments. People keep their savings in banks for several reasons. Funds are generally safer in a bank than elsewhere. A bank checking account provides a convenient way to pay bills. Also, funds deposited in most bank accounts earn interest income for the depositor. People who deposit money in a bank are actually lending it to the bank, which typically pays interest for the use of the funds.

Banks help promote economic growth. Nonfinancial firms borrow from banks to buy new equipment and build new factories. People who do not have enough savings to pay immediately the full price of a home, an automobile, or other products also borrow from banks. In these ways, banks help promote the production and sale of goods and services, and so help create jobs.

Like all businesses, banks try to earn profits. They have traditionally done so by accepting deposits at one rate of interest and then lending and investing those funds at a higher rate. But large banks also earn fees from other activities, such as *brokerage* (buying and selling securities for other investors) or selling insurance.

Banking is nearly as old as civilization. The ancient Romans developed a relatively advanced banking system to serve their vast trade network, which extended throughout Europe, Asia, and much of Africa.

Modern banking began to develop during the 1200's in Italy. The word *bank* comes from the Italian word *banco,* meaning *bench.* Early Italian bankers conducted their business on benches in the street. Large banking firms were established in Florence, Rome, Venice, and other Italian cities, and banking activities slowly spread throughout Europe. By the 1600's, London bankers had developed many of the features of modern banking. They paid interest to attract deposits and loaned out a portion of their deposits to earn interest themselves. By the same date, individuals and businesses in England began to make payments with written drafts on their bank balances, similar to modern checks.

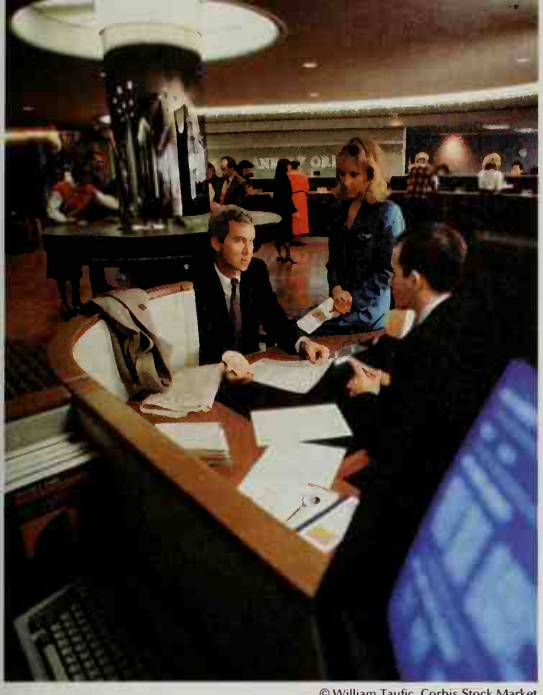
This article discusses banks throughout the world. Because U.S. banks have unique features, however, this article also includes sections on the regulation and the history of banks in the United States. Banks in the United States have been more strictly regulated than banks in many countries as a result of the numerous bank failures that occurred in the United States during the Great Depression of the 1930's. The United States also has more banks and banking assets than any other country in the world.

James R. Barth, the contributor of this article, is Lowder Eminent Scholar in Finance at Auburn University and a Senior Finance Fellow at the Milken Institute.

Bank services

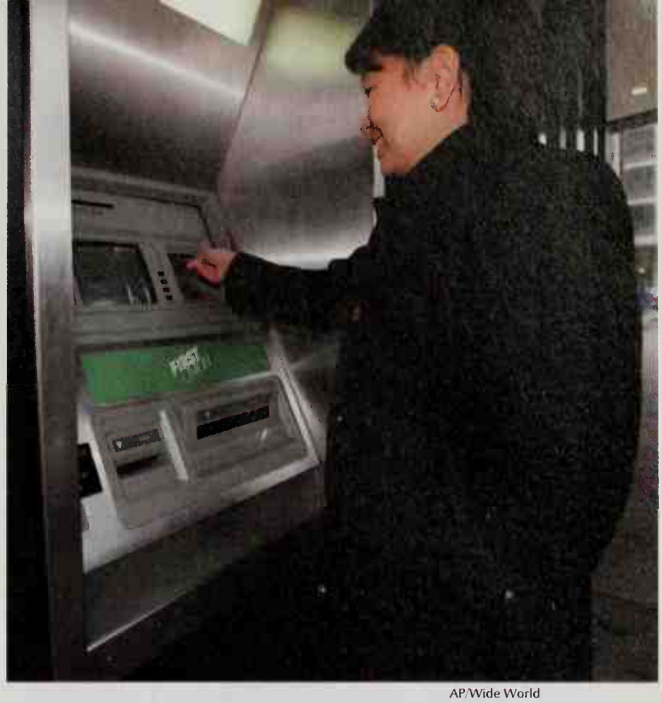
Safeguarding deposits. Deposits in a bank are relatively safe. Banks keep cash and other *liquid assets* available to meet withdrawals. Liquid assets include securities that can be readily converted to cash. Banks are also insured against losses from robberies. But the most important safeguard is the fact that in most countries, governments have established deposit insurance programs. The insurance protects people from losing their deposits if a bank fails.

A bank not only keeps savings safe but also helps them grow. Funds deposited in a savings account earn interest at a specified annual rate. Many banks also offer a special account for which they issue a document called a *certificate of deposit* (CD). Most CD accounts



© William Taufic, Corbis Stock Market

A modern bank provides many services, including checking and savings accounts, loans, and the sale of cashier's checks, money orders, and insurance.



AP/Wide World

Automated teller machines (ATM's) allow bank customers of today to make deposits, transfer funds between accounts, and withdraw cash at any hour of the day or night.

pay a higher rate of interest than regular savings accounts. However, the money must remain in the account for a certain period, such as one or two years, to earn the higher rate of interest. Banks also offer *money market accounts.* These accounts pay an interest rate based on the prevailing rates for short-term corporate and government securities.

Providing a means of payment. People who have funds in a bank checking account can pay bills by simply writing a check and mailing it. A check is a safe method of settling debts, and the canceled check provides proof of payment. Customers may also ask a bank to automatically pay recurring bills, such as telephone and mortgage payments, by a process called *direct deposit deduction.* Many banks allow people to pay bills electronically by telephone or through the Internet.

Many banks offer *credit cards.* People can use the cards to pay for their purchases at stores and other businesses. The bank then pays the businesses directly and sends the customer a monthly bill for the amount charged. The cardholder can usually choose to pay only part of the bill immediately. If so, he or she must pay a finance charge on the unpaid balance.

Banks may also issue *debit cards,* which resemble credit cards. When a cardholder uses a debit card, the amount of the purchase is deducted directly from the cardholder's checking account. Some cards can be used as either credit or debit cards.

Making loans. Banks receive funds from people who do not need them at the moment and lend them to those who do. For example, a couple may want to buy a house but have only part of the purchase price saved. If one or both of them have a good job and seem likely to repay a loan, a bank may lend the couple the additional money they need. To make the loan, the bank uses funds other people have deposited.

A major obligation of a bank is to permit depositors to withdraw their funds upon demand. But no bank has enough cash readily available to satisfy its depositors if all were to demand their funds at the same time. Banks know from experience, however, that such a demand—called a *run*—rarely occurs. If people are confident they can withdraw their funds at any time, they will leave them on deposit at the bank until needed. As a result, banks can loan and invest a large percentage of the funds deposited with them. In most countries, the government limits the percentage of a bank's funds that can be used for loans and investment. The government simultaneously sets a minimum percentage that must be kept on reserve for meeting withdrawals.

Other services. During the late 1900's, banks began to offer a wide range of financial services. For example, a large number of banks offer *mutual funds,* investments in which money from many investors is pooled and used to buy stocks and other securities. Some banks offer financial instruments called *derivatives,* whose payments to investors are based on price changes in certain financial markets, such as the stock market or foreign exchange.

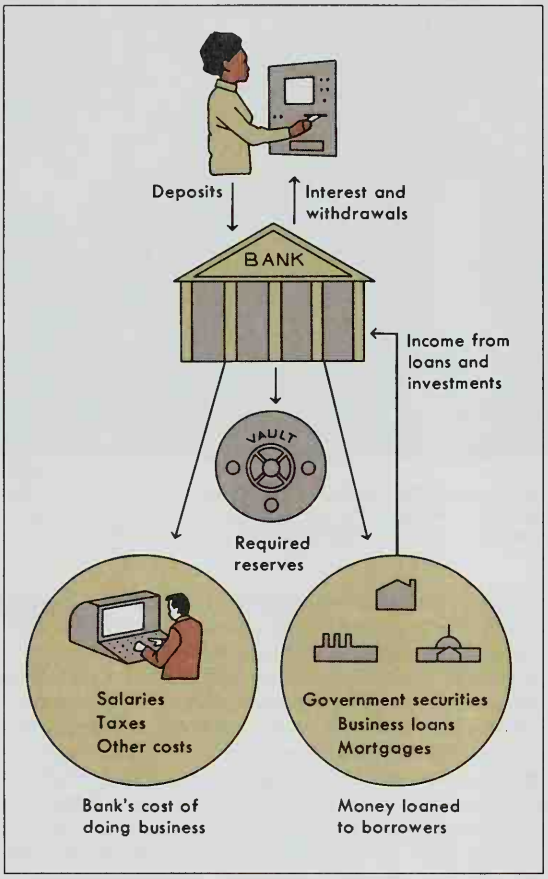
Electronic banking. Many banks have modernized their check-handling facilities with computers and other electronic equipment. An advanced technological system called *electronic funds transfer* (EFT) moves funds from one account to another without the use of checks. EFT includes five types of facilities and systems: (1) automated teller machines, (2) telephone-banking systems, (3) computer-banking systems, (4) automated clearinghouses, and (5) point-of-sale terminals.

Automated teller machines (ATM's), also called *cash machines* or *cash dispensers,* are computer terminals at banks, airports, shopping centers, and many other locations. A customer inserts a special ATM card into the

What happens to bank deposits

After people deposit money, a bank lends it to businesses and other borrowers and collects interest. The bank uses this income to pay its expenses and pay interest to its depositors.

WORLD BOOK diagram



machine and uses a *keypad* (set of buttons or keys) to enter a *personal identification number* (PIN). People use automated teller machines primarily to make deposits, transfer funds between accounts, and withdraw limited amounts of cash. ATM's enable people to do their banking at many locations any hour of the day or night, seven days a week.

Telephone-banking systems enable customers to pay bills and transfer funds from one account to another by calling a special telephone number. Typically, the customer requests a transaction by pressing a sequence of buttons on the telephone in response to recorded messages. In this way, the customer gives instructions to a bank computer, which carries out the transaction.

Computer-banking systems also allow people to pay bills and transfer funds from one account to another at any time. Many banks offer online banking through the Internet. People simply visit their banks' Web sites to do their banking.

Automated clearinghouses are computer centers for the automatic deposit of regular income and the automatic payment of many bills. An employer or the government, for example, instead of issuing paychecks or social security checks, directs the computer to credit a person's account with the person's pay. People can also arrange for insurance premiums, mortgage installments, and other regular payments to be transferred from their bank accounts to the billers' accounts.

Point-of-sale (POS) terminals are computer terminals in retail stores. To pay for a purchase, a customer presents a debit card, which a clerk puts into a terminal. In seconds, the system transfers the amount of the purchase from the customer's bank account to the store's bank account.

In France and other countries, *smart cards* are widely used for purchases. These cards have one or more embedded computer chips that store information about the user's bank balance and purchases. Smart cards store more data than magnetic-stripe cards do, but they cost more to issue and require special terminals.

During the 1990's, many banks in Europe began to use *electronic money,* also called *e-money* or *e-cash.* To make purchases in stores or over computer networks, users simply present proof of stored money value. In one e-money system, banks electronically transfer the customer's stored value onto his or her smart card or other device.

Kinds of banks

Banks differ in the services they provide and in their form of ownership both within and across countries. Financial experts sometimes use the word *bank* to refer only to a commercial bank. Other institutions, such as savings banks, savings and loan associations, and credit unions, do not perform all the functions of commercial banks or are more restricted in performing them. These institutions are often called *thrift institutions,* or simply *thrifts,* because a chief purpose is to encourage saving. Some countries simply divide banks into *deposit-taking institutions* and *credit institutions.*

Most countries also have agencies called *central banks.* Although they are called banks, they do not accept deposits or lend money to the public. Other kinds of banks include investment banks and multilateral development banks.

Commercial banks are the most important banks in terms of assets. They offer a wide range of services, including checking and savings accounts, loans, and *individual retirement accounts* (IRA's). IRA's accumulate interest tax free until funds are withdrawn. Commercial banks traditionally served businesses, but they now meet the financial needs of individuals as well.

A commercial bank is owned by stockholders who buy shares in it. In return for acquiring a bank's stock, stockholders expect the bank ultimately to pay them cash dividends from its profits. In the United States, nonfinancial firms cannot own commercial banks, but most other countries permit such ownership.

Savings and loan associations are another important type of deposit-taking institution. Savings and loans—often called *building societies* or *S & L's*—were established to help people purchase homes. For a long time, they were the chief source of home mortgages. Today, S & L's have become more diversified and offer a variety of services, including checking accounts, IRA's, money market accounts, and consumer and business loans. Several large building societies in the United

Kingdom, for example, have expanded into other types of banking or converted to commercial banks.

In the past, almost all savings and loans were owned and operated by their depositors. But today those owned by stockholders are far more important than those owned by depositors.

Savings banks were created in the United States in the early 1800's as charitable institutions to provide a safe place for poor working people to save for retirement. Originally, almost all savings banks were *mutual savings banks,* which are operated by a board of trustees who elect their own successors. Since the mid-1980's, many savings banks have become *stock savings banks.* These banks are operated by a board of directors who are elected by shareholders. Savings banks offer savings and checking accounts and IRA's. They also make personal and business loans.

Credit unions are formed by people with a common bond. For example, they may work for the same company or belong to the same church. The members pool their savings. When one of them needs funds, he or she may borrow from the credit union, often at a lower rate of interest than from another institution. A credit union distributes its profits to members as dividends on their accounts. Credit unions are important in the United States and Canada. Federal, state, and provincial laws limit credit unions to meeting the needs of their members, and so they do not typically lend to businesses.

Investment banks, also called *merchant banks,* purchase newly issued stocks and bonds from corporations and governments. They then resell the securities to investors in smaller quantities. An investment bank makes a profit by selling securities at a higher price than it pays for them. The first merchant banks were formed by British merchants in the 1800's. In the 1930's, the U.S. government prohibited any institution that accepted deposits and made loans from engaging in investment banking. But in the 1980's, the government began to permit large commercial banks to buy and sell securities within limits. In 1999, it removed the barriers separating investment banking from commercial banking.

Central banks, which in most countries are government agencies, perform financial services for national governments. Their chief responsibility is to help stabilize interest rates, prices, and overall economic activity. Central banks do so by influencing the *money supply,* which is the total quantity of money in a country, including cash and bank deposits.

Central banks also perform a variety of services for other banks. For example, they serve as a *lender of last resort*—that is, they make emergency loans to banks that need cash for unexpected deposit withdrawals. Central banks also handle the *clearing* of checks, the process by which banks settle claims against one another that result from the use of checks.

The functions of central banks differ from country to country. In the United States, the Federal Reserve System, often called simply the *Fed,* is the central bank. The Fed helps regulate and supervise commercial banks. But the Bank of England, the United Kingdom's central bank, does not regulate banks. The Monetary Authority of Singapore carries out most functions of a central bank in that country. However, unlike the Fed and the Bank of England, it does not issue currency.

Multilateral development banks are international financial institutions owned by and funded by member nations. The purpose of these institutions is to provide funds to developing countries for various projects that promote economic and social progress. Although most of the banks channel most of their funds to public projects, some funding is also provided for private ventures.

There are more than 30 development banks worldwide. The five principal banks are the African Development Bank; the Asian Development Bank; the European Bank for Reconstruction and Development; the Inter-American Development Bank; and the World Bank, which is the largest. Every year, these banks commit billions of dollars to projects in developing countries. The multilateral development banks provide not only loans but also grants, technical cooperation, capital investment, and other types of assistance.

Banks throughout the world

The world's largest private banks have headquarters in Germany, Japan, Switzerland, the United Kingdom, and the United States. These banks are multinational corporations, operating in many countries throughout the world. In 1988, banking leaders in these and several other countries agreed to establish international standards for the minimum amount of capital relative to assets that a bank must have. A bank's *capital* is its net worth after all its financial liabilities, such as deposits, are deducted from its assets.

Africa. Kenya, Nigeria, and South Africa have well-developed banking systems with large numbers of both commercial and merchant banks. In most other African countries, large multinational banks with headquarters abroad carry out much of the banking. Some countries, including Algeria and Ethiopia, have *nationalized* their banks—that is, put them under government control. Egypt nationalized its banks in 1961 but restored privately owned banks in 1974. Tanzania nationalized its banks in 1967 but legalized private banking again in 1993.

African countries with large Muslim populations, such as Egypt and Senegal, have special *Islamic banks* that operate according to Islamic rules. Islam forbids the charging of interest, so Islamic banks make special arrangements with the clients to whom they lend money. For example, the client may pay a commission on the loan, or the bank may receive a share of ownership in the client's business. Sudan announced in 1990 that its banking system would follow Islamic principles.

Asia and the Middle East. Hong Kong, Singapore, and Tokyo are the largest banking centers in Asia. Many of the world's richest banks have their headquarters in those three cities. In Japan, large financial institutions called *city banks* serve the banking needs of major industrial firms. Leading city banks include the Bank of Tokyo-Mitsubishi and the Sumitomo Bank. Smaller regional banks serve local businesses and smaller firms.

A large number of Asian countries have both government-owned and private banks. For example, the government of India owns the country's largest commercial banks, but there are hundreds of smaller private banks. Several other Asian countries, including Iraq, Laos, Myanmar, and Pakistan, ended government ownership of banks in the late 1980's or early 1990's.

For many years, Beirut, Lebanon, was the banking center of the Middle East. In the 1970's, however, a civil war broke out between Lebanese Christians and Muslims, and the fighting left Beirut's banking industry in ruins. Bahrain later became the financial hub of the Middle East. Bahrain has encouraged the establishment of *offshore banking units,* banks that may not provide local banking service but do accept deposits from governments and foreign businesses. Other Asian countries with many offshore banking units include the Philippines and Singapore.

Iran nationalized all banks in 1979 and established an Islamic banking system. Many other Asian and Middle Eastern countries, including Bahrain, Malaysia, and the United Arab Emirates, also have Islamic banks.

Australia and New Zealand. Four large commercial banks, usually called *trading banks,* dominate banking in Australia and New Zealand. The four are the Australia and New Zealand Banking Group (ANZ), the Commonwealth Bank of Australia, the National Australia Bank, and Westpac Banking Corporation. In New Zealand, almost the entire banking system is foreign owned.

Europe. The banking system in many European countries is dominated by a few large banks, each with many branches. In the United Kingdom, for example, several large *clearing banks* handle most checking and credit transactions. These banks are Barclays, HSBC, Lloyds, and the Royal Bank of Scotland. Banking in Germany is dominated by four banks—Commerzbank, Deutsche Bank, Dresdner Bank, and HypoVereinsbank. Swiss banking was long concentrated in three institutions, Crédit Suisse Group, Swiss Bank Corporation, and Union Bank of Switzerland. The number was reduced to two in 1998, when Swiss Bank and Union Bank merged to form UBS. Banks in Switzerland attract deposits from many countries because of their reputation for safety and secrecy.

Banks in many European countries offer a wider range of services than banks in other countries do. For example, many German banks are *universal banks* that conduct customary banking plus a wide range of securities and insurance activities.

For part of the 1900's, the Soviet Union and the Communist nations of Eastern Europe had only government-controlled banks. Communist rule ended in much of Eastern Europe during the late 1980's, and the Soviet Union dissolved in 1991. Many Eastern European countries and former Soviet republics then began sweeping reforms of their banking systems. Large numbers of new private banks sprang up.

Latin America. Such countries as Argentina, Bolivia, Brazil, and Chile have both government-owned and private banks. Many foreign-owned banks also operate in those countries. Cuba nationalized all its banks in 1960. Colombia, El Salvador, Mexico, and Nicaragua nationalized many banks in the late 1970's and early 1980's but began to return them to private ownership in the late 1980's and early 1990's.

Canada. The Canadian banking system consists of a small number of commercial banks that control almost all the country's total banking assets. They have thousands of branches throughout the country. In Canada, commercial banks are federally chartered and regulated. The biggest banks may own securities firms, trust companies, and insurance companies.

Canada also has loan companies, which handle deposits and invest primarily in mortgage loans. More than 1,000 credit unions provide consumer credit. Trust companies and loan companies may be regulated by the national or the provincial government. Credit unions are supervised by the provinces.

Regulation of U.S. banks

Commercial banks in the United States must have a state or federal *charter.* A bank charter is a document granting government permission to operate a bank. The type of charter determines whether federal or state officials are the bank's main regulators and supervisors.

Federally chartered banks are called *national banks.* State banks are, on average, smaller than national banks. But a few large banks, such as Morgan Guaranty Trust Company of New York, have state charters.

Regulation of a state-chartered bank is directed mainly by a state official. A state bank may decide voluntarily to join the Federal Reserve System to gain access to the Fed's check-clearing and emergency lending services. The Fed regulates and supervises its member banks and all *bank holding companies* (companies that own and control banks). Regulation and supervision of national banks is performed by the Comptroller of the Currency, an agency of the U.S. Department of the Treasury. All national banks must belong to the Federal Reserve System.

A government corporation called the Federal Deposit Insurance Corporation (FDIC) insures deposits in nearly all the commercial and savings banks in the United States. The FDIC insures each account for a maximum of $100,000. If an insured bank cannot pay its depositors their funds, the FDIC will pay them up to the limit. The FDIC also helps regulate banks. Most S & L's are federally chartered and regulated by another Treasury agency, the Office of Thrift Supervision. The FDIC administers the Savings Association Insurance Fund (SAIF), which insures deposits in S & L's up to $100,000.

Federally chartered credit unions are regulated by the National Credit Union Administration. It administers the National Credit Union Share Insurance Fund, which insures accounts at credit unions up to $100,000.

History of U.S. banking

After winning the war of independence in 1783, the United States struggled to establish its own economic and financial system. Most of the people in the new nation lived on farms, and the only cities were small compared with those in Europe. Industry and trade were undeveloped. Americans had little experience with banks, and they disagreed about what kind of banking system should be established. One group, led by Secretary of the Treasury Alexander Hamilton, wanted to develop an industrial economy and believed large banks were essential. Another group, led by Secretary of State Thomas Jefferson, thought the nation should remain mostly agricultural and opposed the establishment of large banks.

Hamilton and his followers also wanted a strong federal government that had the exclusive authority to charter and supervise banks. Jefferson and his supporters favored states' rights and strict limits on the power of the central government. They insisted that only states should charter and supervise banks.

Rare Coin Company of America, Inc. (WORLD BOOK photo by James Simek)

Bank notes issued by hundreds of banks were used as money in the United States during the early and mid-1800's. This period was known as the Wildcat Period of American banking.

The First Bank of the United States was established by the federal government in 1791. The First Bank, which had a 20-year charter expiring in 1811, functioned as both a commercial bank and a central bank. It made loans and purchased securities, safeguarded deposits, issued currency, and performed a variety of services for the government. The First Bank also regulated the lending practices of state banks and the issuing of *bank notes*. At that time, most of the paper money consisted of bank notes, which were issued by banks rather than governments. The issuing bank promised to exchange its notes for gold or silver coins on demand.

The First Bank was not only the largest bank of its day but also the largest corporation in the country. The federal government provided a fifth of the bank's capital, and private investors supplied the rest.

Many state banks, business firms, and individuals believed that by setting up the First Bank, the federal government had given itself too much power at the expense of the states. As a result, though the bank functioned well, Congress refused to renew its charter in 1811.

After the First Bank ceased to exist, the number of state banks grew rapidly. Most of them issued their own bank notes, which people used as currency. Many banks did not have enough gold and silver coins on hand to exchange for the notes. As a result, much currency was worth less than the value printed on it. To resolve this problem, Congress established the Second Bank of the United States in 1816, also with a 20-year charter.

The Second Bank of the United States resembled the First Bank in its organization and functions. It regulated state banks and limited them from issuing too much paper money and from making loans without enough security. However, President Andrew Jackson and many other Americans viewed the Second Bank as a dangerous monopoly. In 1832, Jackson vetoed the renewal of its charter, which expired in 1836. The United States did not have another federally chartered bank until 1863 or another central bank until 1913.

The Wildcat Period, from the early 1800's to 1863, was a time of widespread problems in U.S. banking. One of the worst problems was a fluctuating money supply. State banks sometimes issued large amounts of bank notes and lent funds freely. At other times, they tightened the money supply and made few loans. These fluctuations led to wide swings in prices and levels of economic activity. Also, many banks had too little capital to support the risky loans they made. As a result, institutions failed, and depositors lost their savings. Counterfeiting was another problem during the Wildcat Period. Because hundreds of banks issued notes of their own design, counterfeiters could easily fool people by inventing fake currencies.

In spite of its many problems, the Wildcat Period probably benefited the economy in some ways. Banks made risky loans that contributed to the nation's economic growth and development by financing new factories, railroads, and other industrial projects.

The national banking system. In 1863 and 1864, Congress passed the National Bank Acts, which allowed for privately owned banks to be chartered by the federal government. The new banks, called national banks, issued uniform notes backed by U.S. government bonds. The issuance of these bank notes was strictly controlled by the government. The government drove state bank notes out of circulation by imposing a tax on their use.

The new national banking system gave the nation a safe, uniform currency. But it did not provide a way to increase the money supply steadily to meet the needs of the growing economy. Periodic shortages of cash, together with inadequate bank reserve requirements, caused a series of financial panics in 1873, 1884, 1893, and 1907. During each panic, many banks closed temporarily because they did not have enough readily available cash for their depositors. Some of those banks never reopened, and the economy suffered.

To prevent new financial panics, Congress passed the Federal Reserve Act of 1913. By creating the Federal Reserve System, this act enabled the federal government to control bank reserves and thus influence the money supply to meet the nation's needs. Many people still worried about the concentration of financial power, however. To ease those concerns, Congress did not create a "single" central bank. Instead, it divided the country into 12 districts, each with its own reserve bank. A board of governors in Washington, D.C., still supervises the system and coordinates the policies of the 12 banks.

The crisis of 1933. The Great Depression hit the United States—and the world—in 1929. Business firms failed, workers lost their jobs, and farmers lost their farms.

Banks had made loans to thousands of people who could not repay what they owed. The Depression also forced many depositors to withdraw their savings. Banks had great difficulty meeting the withdrawals, which came at a time when they were unable to collect on many loans. Furthermore, the *collateral* for the loans had lost value due to the Depression. Collateral is something of value that a borrower pledges to the lender in case the loan is not repaid as promised.

In February 1933, banks in Detroit failed. The blow to public confidence was so great that depositors throughout the country attempted to withdraw cash from their banks. These runs ruined many banks. To stop the panic, President Franklin D. Roosevelt declared a bank holiday on March 6, 1933. All banks closed until federal officials examined the books of each one. Only banks found to be in good condition were allowed to reopen. Many never reopened. Roosevelt's action was designed to help restore public confidence in U.S. banks and put an end to the crisis.

The Banking Act of 1933 also strengthened people's faith in banks. It created the FDIC to insure bank deposits and restricted banking practices that seemed risky. This law is often called the Glass-Steagall Act because it was sponsored by Senator Carter Glass of Virginia and Representative Henry B. Steagall of Alabama.

Changes in banking laws. From the 1930's to the 1960's, bank regulation centered on ensuring financial stability. During the 1960's and 1970's, however, the focus of regulation broadened to include consumer issues, such as fairness in lending. In 1968, Congress passed the Consumer Credit Protection Act, often called the Truth in Lending Act. This law requires banks and other lenders to state clearly the actual annual interest on loans. The Equal Credit Opportunity Act of 1974 prohibits banks from discriminating on the basis of sex or marital status in making loans. Amendments to the act passed in 1976 forbid discrimination on the basis of race, color, religion, national origin, or age. The Community Reinvestment Act of 1977 encourages banks to meet the credit needs of their communities.

A boom in money market funds. During the early 1970's, many private investment companies began to offer money market funds. These funds paid interest rates that exceeded the rates offered by banks and thrifts. As a result, many people withdrew their savings from lower-yielding bank and thrift accounts and deposited them in more attractive money market funds. To help banks and thrifts keep their depositors, the Depository Institutions Deregulation and Monetary Control Act of 1980 gradually raised the federal ceilings on bank interest rates. The act removed interest-rate caps completely by 1986. In addition, it authorized all banks and thrifts to offer interest-bearing checking accounts called *negotiable order of withdrawal* (NOW) accounts.

The Garn-St. Germain Depository Institutions Act of 1982 let banks and thrifts compete directly with money market funds. This act was named for its sponsors, Senator Edwin J. (Jake) Garn of Utah and Representative Fernand J. St. Germain of Rhode Island. It authorized banks to offer federally insured accounts that would pay market interest rates and permit withdrawals on demand. It also allowed banks to sell shares in mutual funds.

The savings and loan crisis. In the 1980's and early 1990's, the savings and loan industry experienced its worst financial crisis since the Great Depression. More than 1,000 institutions failed, and hundreds more were acquired by stronger institutions. Factors contributing to the crisis included lax regulation and supervision, mismanagement and fraud in the industry, and extensive competition from other types of financial firms. The crisis also resulted from the failure of customers to repay their loans. Many customers could not repay because of a recession in agriculture and the petroleum industry and because of a sharp decline in U.S. real estate prices.

The widespread failure of S & L's bankrupted the Federal Savings and Loan Insurance Corporation (FSLIC), the fund that had insured deposits in such institutions since the 1930's. The Financial Institutions Reform, Recovery and Enforcement Act of 1989 dissolved the FSLIC and gave responsibility for insuring savings and loans to the FDIC. The act also created the Office of Thrift Supervi-

© Stone from Getty Images

Brokers at a bank are investment experts who buy and sell a variety of securities. These securities include *municipal bonds* issued by local governments and *corporate bonds* issued by businesses.

sion to regulate S & L's, formerly the job of the Federal Home Loan Bank Board. In addition, the act created the Resolution Trust Corporation to sell the assets of all remaining failed savings and loans. The corporation finished its work in 1995 and was dissolved that same year. To help prevent future problems, Congress passed the Federal Deposit Insurance Corporation Improvement Act of 1991. The act requires federal regulators to intervene whenever a bank's capital falls below a specified level.

Diversification and mergers. During the 1990's, banking began to transform itself into a new industry called *financial services.* Large banks offered a wide variety of services, such as insurance and brokerage. In 1998, the insurance firm Travelers Group Inc. merged with Citicorp bank to become Citigroup, a giant financial services company that operates in dozens of countries.

At the same time, a wave of bank mergers transformed the banking system throughout the world. For example, Japan's Bank of Tokyo and Mitsubishi Bank merged in 1996 to form the Bank of Tokyo-Mitsubishi. Bank mergers in Switzerland reduced the number of Swiss banks by more than one-third during the 1990's. More than 2,000 commercial bank mergers took place in the United States during the same period. For example, NationsBank and BankAmerica, the third- and fourth-largest banks in the United States, merged in 1998 to form the Bank of America.

The merger trend strengthened after Congress passed the Financial Services Modernization Act of 1999, which eased mergers among banking, insurance, and securities firms. The act lifted restrictions imposed by the Glass-Steagall Act of 1933, which had separated banking from securities brokerage, and the Bank Holding Company Act of 1956, which had separated banking from insurance. The 1999 law thus led to the creation of still more large financial services companies.

Careers in banking

Banking offers a variety of careers for college graduates and people with graduate degrees. For example, loan officers arrange complex loans to businesses and individuals. Bond and stock traders buy and sell securities. Trust officers handle *trust funds,* which consist of securities or other property managed by one person or group for the benefit of another. Because banking is information-based and highly regulated, banks also employ many accountants and lawyers. James R. Barth

Related articles in *World Book* include:

Famous banks

Asian Development Bank
Bank of America
Bank of Canada
Bank of England
Bank of the United States
Citibank
World Bank

Kinds of banks

Credit union
Savings and loan association
Savings bank

Bank services

Automated teller machine
Bill of exchange
Certificate of deposit
Check
Credit card
Draft
Investment
Mortgage
Smart card
Traveler's check
Trust fund

Government agencies

Export-Import Bank of the United States
Farm Credit System
Federal Deposit Insurance Corporation
Federal Home Loan Mortgage Corporation
Federal National Mortgage Association
Federal Reserve System
Government National Mortgage Association

History

Bank holiday
Great Depression
New Deal (Helping savers and investors)
Roosevelt, Franklin D. (The banking crisis)
Wildcat bank

Other related articles

Clearinghouse
Credit
Discount (Bank discount)
Interest
Investment banking
Money (Money and the economy)
Money market fund
Switzerland (Banking)

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Questions

What was the Wildcat Period in U.S. banking?
How do banks make a profit?
How does U.S. banking differ from that in other countries?
In what ways is a checking account useful?
What do a bank's trust officers do?
What were some of the causes of the financial crisis in the savings and loan industry during the 1980's and early 1990's?
What are point-of-sale terminals?
Why do people keep their savings in a bank?
How do state banks differ from national banks?

Additional resources

Klebaner, Benjamin J. *American Commercial Banking: A History.* Twayne, 1990.
Mayer, Martin. *The Bankers.* Truman Talley, 1997.
Woelfel, Charles J. *Dictionary of Banking.* Probus, 1994.
Woelfel, Charles J., ed. *The Fitzroy Dearborn Encyclopedia of Banking and Finance.* 10th ed. Fitzroy Dearborn, 1994.

Bank for International Settlements (BIS) promotes cooperation among central banks and other financial institutions. The BIS provides facilities for inter-

national financial operations and serves as an agent or trustee in international financial settlements. It cooperates with the International Monetary Fund (IMF) and the Organization for Economic Cooperation and Development (OECD). The Bank for International Settlements also conducts research and publishes information on economic and monetary matters.

The BIS was established in 1930. Its headquarters are in Basel, Switzerland.

Critically reviewed by the Bank for International Settlements

Bank holiday was the period in 1933 during which President Franklin D. Roosevelt closed all banks in the United States. The president declared a bank holiday on March 6, 1933, to help stop the money panic in the nation. Depositors had been withdrawing their funds so fast that many banks ran out of money to pay over the counter. A large number of these banks had collapsed or closed.

On March 9, 1933, Congress passed the Banking Act of 1933. This act allowed financially sound banks to reopen and ordered reorganization of others. It helped restore public confidence in banks (see **Federal Deposit Insurance Corporation**). In the United Kingdom, *bank holiday* means the same as *legal holiday* in the United States. James T. Patterson

Bank of America is one of the largest commercial banks in the United States. It was created in 1998 by the merger of BankAmerica and NationsBank, two large U.S. bank holding companies. BankAmerica was the holding company for an earlier Bank of America. That bank was founded in San Francisco by Amadeo P. Giannini in 1904 and was called the Bank of Italy until 1930. The Bank of America is headquartered in Charlotte, North Carolina.

Critically reviewed by the Bank of America

Bank of Canada is Canada's central bank. It is owned by the Canadian government. The bank regulates Canada's credit and currency and acts as the government's financial agent. For example, it manages Canada's public debt and advises the government on economic matters.

The bank does not accept deposits from individuals. Instead, it receives deposits from central banks of other countries and from such financial organizations as the International Monetary Fund (IMF) and the World Bank. In addition, the Bank of Canada has the sole right to issue paper money for circulation in Canada.

The Bank of Canada was founded in 1934, and it began operations in 1935. Its headquarters are in Ottawa.

Critically reviewed by the Bank of Canada

Bank of England is the central bank of the United Kingdom. It corresponds to the Federal Reserve System of the United States and the Bank of Canada. It issues nearly all of the country's bank notes. It handles the nation's official foreign-exchange operations and manages its gold and foreign-exchange reserves.

The Bank of England is in London. It was founded in 1694. Only Sweden has an older central bank. The Bank of England was owned by private stockholders until 1946, when the government bought all its stock.

Critically reviewed by the Bank of England

Bank of the United States was the name of two national banks established by the U.S. government. The first was chartered in 1791 and the second in 1816.

When the new U.S. government was set up in 1789, many of its leaders wanted a national bank. Alexander Hamilton, secretary of the treasury, thought such a bank would strengthen the government politically and promote the nation's economic growth. The few state-incorporated banks that existed then had small resources and were too isolated to handle the government's financial operations. Merchants and traders also needed additional banking facilities. Secretary of State Thomas Jefferson saw a national bank as a powerful financial monopoly, dangerous to American freedoms. Some members of Congress doubted the constitutionality of such a bank. But the bank's charter was granted in 1791, and it opened in Philadelphia later that year.

The First Bank of the United States (1791-1811) had a capital of $10 million. The U.S. government supplied $2 million of this capital. The bank was authorized to issue notes, make loans, and hold deposits. It had eight branches in important commercial cities.

The bank issued notes that were accepted in all payments to the United States, and the public regarded them as good as gold. The bank handled payments of the public debt for the Treasury, received subscriptions for new issues of government securities, and paid the salaries of public officials. It kept state-incorporated banks from issuing excessive amounts of notes that they might not be able to convert into coin. The government sold its stock in the bank in 1802 at a good profit. But many people still opposed the bank. Its charter was not renewed, and the bank ceased to exist in 1811.

The Second Bank of the United States (1816-1836). At the end of the War of 1812, the United States had a gravely disordered currency. Except in New England, bank notes were used as a common means of payment, but these notes could not be converted into gold or silver. Commodity prices and real estate values became inflated. The Treasury tried to collect revenues from import duties and from the sale of public lands. But much of this revenue was in state bank notes not worth their face value in gold and silver. Many people hoped a Second Bank of the United States would fix this problem.

The second bank began in 1816 with a capital of $35 million. The government again owned one-fifth of the capital, $7 million. The bank established branches throughout the country, and its powers were in general like those of the First Bank of the United States. Early in its career, the bank made some unwise loans to speculators. Even so, it proved useful to the Treasury, and it aided state banks in redeeming their notes in coin.

A new president of the bank, Langdon Cheves, rescued it from near financial disaster in 1819. Cheves stopped loans to speculators and improved the bank's organization. In 1823, Nicholas Biddle became president. Under his management, the bank prevented the fluctuations in receipts and payments by the United States from seriously disturbing the money markets of the country. By the sale of branch *drafts* (notes), business people could send money inexpensively from one part of the country to another. The bank efficiently handled foreign payments that arose from increasing American trade in the international market. For many years, the bank prevented state banks from issuing too many notes.

In 1832, Biddle's supporters in Congress introduced a bill to recharter the bank even though the existing charter would not expire for four years. President Andrew Jackson, who was suspicious of banks, regarded the

bill as part of a plan to block his reelection. Jackson vetoed the bill and later removed government deposits from the bank. The bank's charter expired in 1836, and the bank ceased to exist as a federally incorporated institution.

The bank continued to operate for about five years under a charter granted by the state of Pennsylvania. It failed in 1841, largely because it attempted to carry on an international investment banking business. Many private and state banks sprang up, and the bank notes they issued could not always be redeemed. The national bank acts passed by Congress in 1863 and 1864 authorized creation of privately owned banks with charters from the federal government. The Comptroller of the Currency supervised these banks. They issued currency secured by government bonds. James C. Curtis

See also **Bank** (History of U.S. banking); **Biddle, Nicholas**; **Jackson, Andrew** (The Bank of the United States).

Banker. See Bank (Careers in banking).

Bankhead, Tallulah, *tuh LOO luh,* (1903-1968), was an American stage and motion-picture actress. She was noted for her husky voice and colorful, sophisticated personality. She received praise for her performances in the plays *The Little Foxes* (1939) and *The Skin of Our Teeth* (1942). Her best-known film performance came in *Lifeboat* (1944).

Tallulah Brockman Bankhead was born in Huntsville, Alabama. She made both her motion-picture debut and her Broadway stage debut in 1918. From 1923 to 1931, Bankhead lived in London, where she became a popular stage actress. John F. Mariani

Banking. See Bank.

Bankruptcy is the state of being legally unable to pay debts. A court may declare both individuals and businesses to be bankrupt. The term *bankrupt* comes from an Italian word meaning *broken bench.* An old Italian custom supposedly called for breaking the benches or tables of bankers and moneylenders whose businesses had failed. The word *bankrupt,* or *debtor,* also refers to an indebted person or business involved in bankruptcy proceedings.

American and British laws divide bankruptcy into two main categories, *voluntary* and *involuntary.* Voluntary bankruptcy occurs if a debtor requests to be declared bankrupt. Involuntary bankruptcy occurs if a debtor's *creditors,* the people or businesses that are owed money, ask that the debtor be declared bankrupt.

A debtor's property may be sold as part of bankruptcy proceedings, under official supervision. The money obtained from the sale pays expenses, such as court costs and trustees' fees, and then is divided among the creditors. For example, if the debtor owes $100,000, but only $50,000 can be obtained after costs, the creditors would each receive half the amount owed them. In most cases, the court also *discharges* (frees) a debtor from remaining debts. A discharge gives the debtor a chance to make a new financial start.

In the United States, the Constitution authorizes Congress to establish uniform bankruptcy laws throughout the country. The Bankruptcy Code of 1978 updated the Bankruptcy Act of 1898 and the amendments to the act that were passed in 1938. In the Bankruptcy Code, the term *debtor* replaced *bankrupt* in referring to the subject of cases under the code. These cases are called *liquidation cases* or *reorganization cases* rather than *bankruptcy cases.*

Bankruptcy courts handle all petitions for liquidation or for reorganization of a financially troubled business. Bankruptcy courts are units of the U.S. district courts, and they are under the supervision of the district court judges. Individuals and businesses—except banking, insurance, and municipal corporations—can file petitions for voluntary liquidation. Individuals file in about 85 percent of such cases in the United States.

Creditors file petitions to have a person or business declared involuntarily bankrupt. The court may declare a debtor involuntarily bankrupt if the debtor is *insolvent*—that is, if the debtor is unable to pay debts as they become due. Under some state laws, a custodian, such as a *receiver,* may take possession of the debtor's property for the benefit of creditors (see **Receiver**). Then, within 120 days, creditors may file an involuntary bankruptcy petition in a bankruptcy court.

After a petition has been filed, a meeting of the creditors is called to investigate the debtor and the causes of bankruptcy. Creditors must file a claim within a certain period of time for the amount that is owed them.

An uninvolved party, called a *trustee,* may sell the debtor's property and distribute the proceeds among the creditors. Debtors may keep certain personal and household items rather than sell them to meet the claims of the creditors. Exemptions are set by individual state laws and by the Bankruptcy Code of 1978. The debtor may choose either list of exemptions, unless state laws forbid use of the federal list. The trustee may be elected by the creditors. But most bankruptcy cases are managed by trustees appointed by officials of the U.S. Trustee System, a part of the Department of Justice.

Although a debtor may be discharged from some debts, certain other debts, such as alimony, child support, and taxes, cannot be discharged. The court also may refuse a discharge if the debtor was previously discharged within six years. The Bankruptcy Code lists other acts of the debtor that may be cause for the court to deny a discharge. These include certain forms of dishonesty and fraud.

The law provides guidelines for the rehabilitation or reorganization of a business in financial distress. It allows an individual with a regular income to work out a plan with creditors for full or partial payment of debts. In 1986, an amendment to the Bankruptcy Code gave family farmers special reorganization rights to protect their ownership of farmland.

In Canada, bankruptcy procedures resemble those of the United States. The British North America Act of 1867 gave the Canadian Parliament jurisdiction over bankruptcy laws in Canada. Parliament enacted and amended bankruptcy laws several times through the years. In 1949, Parliament passed a bankruptcy act that, along with later amendments, forms Canada's present uniform bankruptcy code. John Krahmer

Banneker, Benjamin (1731-1806), was probably the best-known black person in early United States history. He was an astronomer, farmer, mathematician, and surveyor.

In 1791, Banneker was an assistant to Major Andrew Ellicott, the surveyor appointed by President George Washington to lay out the boundaries of the District of

Columbia. Secretary of State Thomas Jefferson had recommended Banneker for this work.

Banneker was born on Nov. 9, 1731, near Baltimore. His grandmother, an Englishwoman, taught him to read and write. For several winters, he attended a small school open to blacks and whites. There he developed a keen interest in mathematics and science. Later, while farming, Banneker pursued his mathematical studies and taught himself astronomy. In 1753, he completed a clock built entirely of wood, each gear carved by hand. His only models were a pocket watch and a picture of a clock. The clock kept almost perfect time for over 50 years.

Detail of a woodcut (1795) by an unknown artist for Benjamin Banneker's Almanac; Maryland Historical Society

Benjamin Banneker

From 1791 to 1796, Banneker made all the astronomical and tide calculations and weather predictions for a yearly almanac. Banneker sent Jefferson a copy of his first almanac. With it he sent a letter calling for the abolition of slavery and a liberal attitude toward blacks. Banneker's skills impressed Jefferson. Jefferson sent a copy of the almanac to the Royal Academy of Sciences in Paris as evidence of the talent of blacks. Opponents of slavery in the United States and England also used the almanacs as evidence of the abilities of black people.

The publishers of Banneker's almanacs printed contributions by prominent Americans in addition to his material. In the 1793 almanac, for example, the surgeon and statesman Benjamin Rush proposed the appointment of a U.S. secretary of peace. Banneker probably contributed a few proverbs, essays, and poems to the almanac.

Raymond W. Smock

Additional resources

Bedini, Silvio A. *The Life of Benjamin Banneker.* 2nd ed. Md. Hist. Soc., 1999.
Litwin, Laura B. *Benjamin Banneker.* Enslow, 1999.
Maupin, Melissa. *Benjamin Banneker.* Child's World, 2000. Younger readers.

Bannister, Sir Roger (1929-), a British athlete, became the first man to run a mile in less than four minutes. He ran a mile in 3 minutes 59.4 seconds, at Oxford, England, on May 6, 1954. His record was broken a month later by John Landy, an Australian. Bannister defeated Landy in a mile race in August 1954. Bannister's time was 3 minutes 58.8 seconds, and Landy's was 3 minutes 59.6 seconds. Bannister retired from athletic competition in 1955 in order to practice medicine. He was knighted by Queen Elizabeth II in 1975. Bannister was born on March 23, 1929, in Harrow, England.

Michael Takaha

Bannock Indians are a tribe that once hunted throughout the northern Rocky Mountains. They are related to the Northern Paiute and the Shoshone, with whom they have frequently intermarried.

Like the Shoshone, the Bannock traveled in small bands hunting buffalo and other game and fishing for salmon. They also ate the roots of the camas, a plant that grew wild on the prairie. In the early 1700's, the Bannock acquired horses and became skilled riders.

The Bannock were expert weavers who made baskets from prairie grass. In summer, the Bannock lived in houses made of reeds and roofed with grass mats. In winter, they built small, round lodges that were partly underground.

In the 1820's, Jim Bridger, James P. Beckwourth, and other American explorers became the first non-Indians to meet the Bannock. At that time, the Bannock had a population of about 1,500. Their numbers declined to about 600 by the 1860's. This drop resulted from smallpox epidemics and almost constant warfare with the Blackfeet and Nez Perce Indians and white settlers. In 1863, the U.S. Army defeated a force of Bannock and Shoshone warriors at the Battle of Bear River. In 1867, the government assigned the two tribes to the Fort Hall Reservation in Idaho.

In 1878, the Bannock rebelled and fled the reservation because the government had failed to supply them with enough food. During this uprising, known as the Bannock War, United States troops killed a large number of Bannock warriors, including their leader, Chief Buffalo Horn. The tribe was defeated after the Army attacked a Bannock village and shot a large number of women and children.

Today, about 3,000 descendants of the Bannock and Shoshone live on the Fort Hall Reservation. Many of them are poor and have leased their land to white farmers. Some of the Indians have jobs in factories or on potato farms near the reservation. Thomas H. Johnson

Bannockburn, Battle of, was one of the most important battles in the history of Scotland. It was fought at Bannockburn, Scotland, in 1314. The Scots saved their country from foreign rule by defeating the English. Robert Bruce won the throne of Scotland by this victory. The English outnumbered the Scots, but they were poorly led by King Edward II. The Scots fought from a better position and the English were too cramped for space to use their superior numbers. The Scots stopped the Eng-

Pictorial Parade

Roger Bannister was the first person to run a mile in less than four minutes. In 1954, Bannister ran a mile in 3 minutes 59.4 seconds in a race, *shown here,* at Oxford, England.

lish partly by digging pits along the line of the attack. The English fled after suffering heavy losses.

Robert Burns wrote a poem, "Bruce to His Men at Bannockburn." It contains the line, "Scots, wha hae wi' Wallace bled." The line refers to Sir William Wallace, a hero in the struggle for Scottish independence. Wallace led the Scots in a series of battles against the English between 1297 and 1305, when the English captured and executed him. John Gillingham

See also **Bruce, Robert.**

Banns of marriage. See **Marriage** (Laws concerning marriage).

Banshee was an old woman in Irish legend. Her shrieks and wailings outside a house meant that there was to be a death inside. In earliest times, she was a fairy who protected the ruling family of a district. Later, her cries merely told of a coming death. She never mourned for obscure people. Ellen J. Stekert

Bantam is any one of a number of miniature fowl—especially chickens. Most bantams weigh less than $1\frac{1}{2}$ pounds (0.68 kilogram), but the males of some breeds may weigh more than 2 pounds (0.9 kilogram). Some bantam breeds have distinctive characteristics, but others resemble varieties of larger chickens.

People raise bantams chiefly as a hobby and to exhibit in shows. They breed bantams primarily for body size and for feather color. Some breeds also are noted for such unusual characteristics as clusters of feathers on the legs or on other parts of the body. In addition, a few breeds of bantams are fairly good egg producers and are raised for their small eggs. Meat from young bantams can be good to eat, but that from older birds may be tough. Melvin L. Hamre

See also **Chicken** (Other classes; picture: Some kinds of chickens).

Banting, Sir Frederick Grant (1891-1941), a Canadian surgeon, was the principal discoverer of insulin. In 1921, Banting was given laboratory space at the University of Toronto. There, he worked with John James Rickard Macleod, Charles Herbert Best, and James Bertram Collip to isolate a hormone from the pancreas that would control diabetes.

With Macleod's leadership and Collip's knowledge of chemistry, the team isolated the insulin hormone in only eight months. At the time, Banting was 30 and Best was a 22-year-old physiology student. The discovery of insulin was published in 1922. The discovery was one of the most important contributions in the history of medicine and revolutionized the treatment of diabetes (see **Diabetes; Insulin**).

Banting and Macleod received the 1923 Nobel Prize for medicine for the discovery. When they learned about the award, Banting telegraphed his co-worker, Best, "You are with me in my share always." Macleod in turn shared his prize money with Collip. See **Best, Charles Herbert.**

Banting was born on a farm near Alliston, Ontario, and graduated from the University of Toronto. He served as a physician in the Canadian Army during World War I (1914-1918). He was wounded in the hand during the war, and received the Military Cross for conspicuous bravery. After the war, Banting became an instructor of physiology at the University of Western Ontario.

Banting was in charge of research at Banting Institute, Toronto, when he joined the Canadian Army as a major during World War II. He was killed in an airplane crash over Newfoundland in 1941 while on his way to England. Dale C. Smith

Additional resources

Bliss, Michael. *Banting: A Biography.* 1984. Reprint. Univ. of Toronto Pr., 1993. *The Discovery of Insulin.* 1982. Reprint. Univ. of Chicago Pr., 1984.

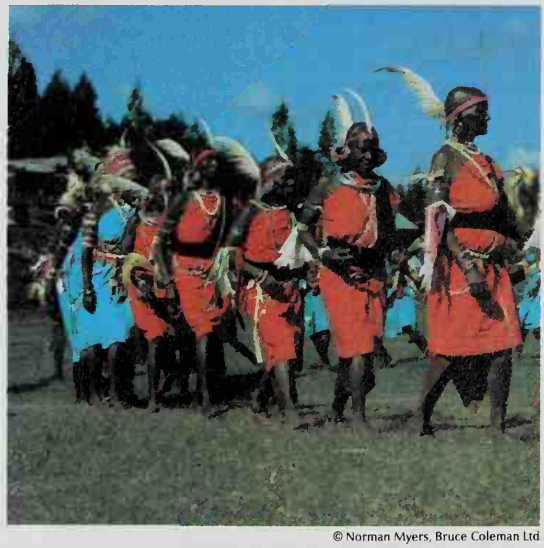
Harris, Seale. *Banting's Miracle: The Story of the Discoverer of Insulin.* Lippincott, 1946.

Bantu, *BAN too,* are a large group of African black peoples. The word *Bantu* also refers to the related languages spoken by these peoples.

More than 180 million Africans speak Bantu languages. These people make up a major part of the population of nearly all African countries south of 5° north latitude. They belong to about 300 groups, each with its own language or dialect. Every Bantu group considers itself a separate cultural and political unit, and each has its own name and history. Groups vary in size from a few hundred members to several million. The best-known ones include the Zulu, once feared as warriors in South Africa; the Swahili, whose language is spoken throughout eastern Africa; and the Kikuyu, the largest group in Kenya. See **Kikuyu; Swahili; Zulu.**

The first Bantu probably lived in what is now Cameroon. But about the time of Christ, the Bantu began one of the greatest migrations in history. Their growing population caused them to move to new lands. These people were farmers who knew how to make iron tools and weapons. They brought the knowledge of ironworking to much of Africa. The migration occurred gradually, with small groups continually splitting off and moving to new regions. These groups slowly developed into the cultural units of today.

By 1500, Bantu peoples had moved into most of central, eastern, and southern Africa. Such groups as the Ganda, Kongo, Luba, Lunda, Nyoro, and Rwanda estab-



© Norman Myers, Bruce Coleman Ltd.

The Bantu are a large group of peoples who live in central and southern Africa. They include the Kikuyu of Kenya, *above.*

lished great kingdoms in central Africa. Their power was greatly reduced under colonial rule.

The government of South Africa formerly used the term *Bantu* to refer to that country's black population. But black South Africans considered the term offensive and preferred to be called *blacks.* In 1978, the government dropped *Bantu* from official use. T. O. Beidelman

Bañuelos, *bah nyoo WAY lohs,* **Romana Acosta,** *roh MAH nah ah KOHS tah* (1925-), served as treasurer of the United States from 1971 to 1974 under President Richard M. Nixon. She was the first Mexican-American woman to hold such a high government post.

U.S. Dept. of the Treasury

Romana Bañuelos

As treasurer, Bañuelos' signature appeared on all paper currency. Her responsibilities included writing checks for funds spent by government agencies and destroying worn-out currency.

Bañuelos was born in Miami, Ariz., and grew up in Mexico in the states of Sonora and Chihuahua. She began her career in 1949 with a small investment in a tortilla stand in Los Angeles. Her business grew into a $5-million food enterprise. In 1964, Bañuelos founded the Pan American National Bank of East Los Angeles. It is the only United States bank owned and operated by Mexican Americans. In 1969, she organized a college scholarship program for Mexican-American students. Cynthia Fuchs Epstein

Banyan tree, *BAN yuhn,* is a kind of fig tree that grows in India and adjacent countries. A single banyan has many trunks and can look like a small forest. The tree grows in a peculiar way. Birds drop banyan seeds into the top branches of palms and other trees. The seeds sprout in the treetops and branches develop. Eventually, the branches send roots down to the ground. These supports then enlarge into trunks and develop new branches. In time, the banyan kills the supporting tree by strangling it.

A fruit much like the edible fig grows on the banyan tree but it is not good to eat. The largest banyan tree known is on the island of Sri Lanka. It has 350 large trunks and over 3,000 small ones.

The wood of the banyan tree is soft and porous. Its white, sticky latex is used to prepare *birdlime,* which hunters use in capturing birds. The banyan tree gets its name from the Hindu word *banian,* meaning *trader.*

Scientific classification. The banyan tree belongs to the mulberry family, Moraceae. It is classified as *Ficus bengalensis.* Alwyn H. Gentry

© Susan Pierres from Peter Arnold

The banyan tree grows in Asia. Its branches have hanging supports that grow down to the ground, take root, and begin new trunks. One banyan tree may have thousands of trunks.

Baobab, *BAY oh bab* or *BAH oh bab,* is the name of a group of trees that grow in tropical and subtropical regions of the Eastern Hemisphere, especially in Madagascar. The best-known type of baobab is found on the African mainland. It has an extremely thick, often bulging, trunk. This tree may grow to 60 feet (18 meters) tall with a trunk from 30 to 50 feet (9 to 15 meters) in diameter. Many live up to 1,000 years or more. The tree has white flowers that open at night and are pollinated by bats. The fruit, called *monkey bread,* is almost 1 foot (30 centimeters) long. It dangles from the tree like a lantern from a long, ropy stem. The fruit holds many seeds buried in a mealy pulp. The pulp serves as food or as a flavoring for cool drinks. People sometimes use the leaves and bark in medicines. They make paper, cloth, and rope from the bark fibers.

Scientific classification. Baobabs belong to the bombax family, Bombacaceae. The most commonly known species is *Adansonia digitata.* Alwyn H. Gentry

See also **Kapok; Tree** (picture: The baobab tree).

© R. Van Nostrand, Photo Researchers

The fruit and flowers of the baobab hang from stems that are long and ropy.

© K. W. Fink, Bruce Coleman Inc.

A baobab's trunk contains much water-storage tissue but little wood.

© M. P. Kahl, Bruce Coleman Inc.

A baobab grows on the hot, dry, grassy plains of Africa, *above.* The tree has a thick trunk and short branches.

Sally Wayland

Baptism is an important Christian ceremony. In the Lutheran baptism shown here, the minister has dipped his fingers in the font of water and is placing them on the child's head.

Baptism is a symbolic washing with water as a religious practice. It indicates or transmits purification, the washing away of sins, and the start of a renewed life. Baptism is most important in the Christian religion. But many other religions include ceremonies that are similar to Baptism.

Nearly all Christian churches baptize. They follow the example of Saint John the Baptist and the instructions of Jesus Christ and Saint Paul, as set forth in the New Testament. Most churches consider baptism to be the main ceremony signifying a person's entry into the Christian community.

In a typical Christian baptism ceremony, the person being baptized makes a statement of faith in Jesus. Sponsors, called *godparents,* may make the statement on behalf of infants. In most cases, a priest or minister then pronounces the person's name and administers the water, saying, "I baptize you in the Name of the Father, of the Son, and of the Holy Spirit," or similar words. Often, infants are *christened* (named) during the baptism ceremony. *Christening* also refers to baptism itself.

The meaning and procedure of baptism vary among Christian churches. For example, the Anglican, Eastern Orthodox, Lutheran, Methodist, Reformed, and Roman Catholic churches consider baptism a sacrament or ordinance. According to these churches, baptism gives or expresses God's grace in a person, regardless of the individual's awareness of it. As a result, they baptize infants as well as adults. Most of these churches usually administer baptismal water by pouring or sprinkling it. The Eastern Orthodox Churches practice *immersion* (submerging a person into water).

Baptist and similar churches believe that baptism should follow a voluntary, public statement of faith in Jesus Christ as savior. Therefore, they do not baptize people who are too young to realize the significance of such a statement. Robert S. Ellwood, Jr.

See also **John the Baptist, Saint; Roman Catholic Church** (Baptism); **Religion** (picture).

Baptists are members of a large Protestant religious group who reserve baptism for adult or mature persons who affirm their faith in Jesus Christ as their savior. Baptists are organized in separate *conventions* or *associations.* Many of these organizations belong to the Baptist World Alliance. Over 26 million Baptists in the United States form the largest single Baptist group in the world.

The Baptist movement developed as one wing of English Congregationalism during the early 1600's. These Baptists, like some earlier Christian groups, opposed the baptism of infants. They insisted that baptism should be restricted to believers who are old enough to make their own declaration of faith. Later in the 1600's, these Baptists said that baptism should be by *immersion* (dipping under water), rather than by pouring or sprinkling the water.

Early history. The earliest Baptist leader was John Smyth, a clergyman in the Church of England. About 1607, Smyth went to the Netherlands with those English exiles who later became the Pilgrims of New England. While in the Netherlands, Smyth and 36 of the exiles formed a Baptist church. Differences of opinion developed within the church, and 11 members of the new congregation broke away. These members returned to England to form a church there in 1611. However, major Baptist growth did not occur in England until the Puritan revolution.

Except for the issue of baptism and a strong defense of freedom of conscience, there was little to distinguish early Baptists from Congregationalists. All the Congregationalists feared the authority of bishops and *synods* (councils) and strongly declared the rights of lay people and local congregations to govern themselves. Most Baptists accepted as their doctrine a slightly modified Westminster Confession of Faith formulated by the Puritans in the 1640's.

William Carey, an English Baptist who went to India in 1793, was one of the first English-speaking Christian missionaries. American Baptists joined the foreign missionary movement in 1812 when Adoniram Judson went to Burma (now Myanmar), and missionaries later went to Europe and Latin America. As a result of this activity and the movement of British Baptists into Canada, Australia, and New Zealand, most countries today have at least a small Baptist community.

Baptists in America. In the American Colonies, Roger Williams formed a Baptist church in Providence, Rhode Island, in 1639. Philadelphia later became the major Baptist center in colonial America. During the years immediately before and after the Revolutionary War, the number of Baptists increased greatly. By 1800, the Baptists were the largest denomination in America. However, during much of the 1800's, the Methodists outnumbered the Baptists. In the 1900's, the Baptists expanded to once again form the largest Protestant denomination in America.

About half of the Baptists in the United States are affiliated with the Southern Baptist Convention. The two black national Baptist groups—the National Baptist Convention of America, Inc., and the National Baptist Convention, U.S.A., Inc.—form another large segment. A fourth major group, the American Baptist Churches in the U.S.A., is the oldest continuously active Baptist group. The leading Canadian body of Baptists is the Baptist Federation of Canada.

During the 1900's, the Baptists, like most other Protes-

tants, were divided on matters of theology. Modernists and fundamentalists differed on how best to understand the Bible. Modernists emphasized studying the Bible historically rather than as the literal word of God. Fundamentalists feared that the authority of Scripture, and thus the basis of Christianity, was being undermined by the new methods of Bible study and by acceptance of modern scientific theories. Today, controversy over these two points of view is still strong, especially among Southern Baptists. Henry Warner Bowden

Related articles in *World Book* include:

American Baptist Association
American Baptist Churches in the U.S.A.
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Fosdick, Harry Emerson
Fundamentalism
Judson, Adoniram
King, Martin Luther, Jr.
National Baptist Convention, U.S.A., Inc.
National Baptist Convention of America, Inc.
National Primitive Baptist Convention in the U.S.A.
Southern Baptist Convention

Additional resources

Brackney, William H. *Historical Dictionary of the Baptists.* Scarecrow, 1999.

Harrington, Patricia. *I Am Baptist.* PowerKids Pr., 1999. Younger readers.

Bar. See **Barometer**.

Bar. See **Music** (Indicating time values).

Bar, in law, is the general name for the whole legal profession. The term first referred to the courtroom railing dividing the space reserved for lawyers and judges from the public section. *Admission to the bar* now means permission to practice law. See **Law** (Licensing of lawyers); **Inns of Court**.

Bar coding is a method of labeling retail products and other items. A bar code consists of a pattern of lines and bars that a computer can translate into information about an item.

Many supermarkets and other retail establishments have computerized cash registers that can read a type of bar code called the *Universal Product Code* (UPC). This code, which is printed on a wide variety of products, includes 11 digits and lines and bars.

At a store's checkout counter, a clerk passes the bar code of each purchase facedown over a small window in the counter. An *optical scanner* below the window beams a light across the code and interprets it as a sequence of numbers that represents the product. The store's computer uses the numbers to search a database for product information. It relays the price and a short product description to the cash register, which displays the information on a screen and prints the information on a paper sales slip. The computer records the sale so that it can track the store's stock of each item.

The digits listed on a UPC contain the same information as the bars and lines. The clerk keys these numbers into the computer if the scanner fails to read the code.

The Universal Product Code first appeared on supermarket products in 1973. Since then, similar codes have been developed for use in factories, warehouses, hospitals, and libraries. In an automobile factory, for example, engines are labeled with bar codes. Before an engine is put into a car, a scanner automatically reads the bar code on the engine. A computer then indicates if the engine is the right one for the car. Bar codes with lines or patterns that run both vertically and horizontally can store a large amount of data in a small space. Such codes are used on the back of some driver's licenses to store information about the driver. Russ Adams

See also **Laser** (Scanning).

Bar mitzvah, *bahr MIHTS vuh,* is the entry of a Jewish boy into the adult Jewish community. The boy who has attained religious adulthood is called a *bar mitzvah.* The term means *son of the commandments.* The celebration of the occasion is also called a *bar mitzvah.*

When a Jewish boy reaches physical maturity, assumed to be the age of 13, he is responsible for all the observances, obligations, and prohibitions of a Jewish adult. No formal religious ceremony is needed for this to happen. Traditionally, however, a boy demonstrates his new status by participating in or, preferably, leading public worship. He may conduct a public service, read from the *Torah* (Law) in Hebrew, or chant a portion from the Biblical prophets. After the service, it is customary for the bar mitzvah's parents to host a party. Friends, relatives, and members of the Jewish community are invited to share in the festivities. B. Barry Levy

See also **Bat mitzvah; Judaism** (Special occasions).

Barabbas, *buh RAB uhs,* was a man mentioned briefly in all four Gospels. Barabbas was a Jewish prisoner of the Romans at the same time as Jesus. He had been in prison for committing a murder during a rebellion. Barabbas may have been a member of the Zealots, a radical Jewish religious revolutionary group that frequently started uprisings. Barabbas means *son of the Father* and may indicate a hope in the coming of the Messiah, which always troubled the Romans.

It was apparently a custom for the Roman governor to release one Jewish prisoner at the Passover season. Pontius Pilate, the Roman governor of Judea, took Jesus and Barabbas to the steps of his palace and asked the crowd gathered there to choose which one should be released. The crowd chose Barabbas, and Pilate released him. Nothing is known of Barabbas outside the Gospels. M. Robert Mulholland, Jr.

Barak, Ehud, *eh HOOD* (1942-), a Labor Party politician, served as prime minister of Israel from 1999 to 2001. As prime minister, Barak revived peace talks with the Palestine Liberation Organization (PLO), which had stalled under the previous prime minister, Benjamin Netanyahu. The negotiations concerned control of the Gaza Strip and West Bank—areas Israel had occupied in 1967—and other issues. In October 2000, however, Barak suspended the peace talks following several weeks of violent clashes between Palestinian demonstrators and Israeli security forces. In an election for prime minister held in 2001, Barak lost to Ariel Sharon, the leader of the conservative Likud party. See **Sharon, Ariel.**

Agence France-Presse

Ehud Barak

Barak was born Ehud Brog in a collective community called a *kibbutz* on the Mediterranean coast of what is now Israel. He earned a B.S. degree in physics and mathematics from Hebrew University in Jerusalem in 1968 and an M.S. degree in economic

engineering systems from Stanford University in the United States in 1978.

Barak joined the Israeli army in 1959. He changed his name from Brog to Barak when he became an officer. *Barak* means *lightning* in Hebrew. Barak held several positions of command, including army chief of staff from 1991 to 1995. In 1995, he left the army for politics and served first as interior minister and then as foreign minister. He was elected Labor Party leader in 1997. He resigned as Labor leader in 2001. Bernard Reich

Baraka, *buh RAH kuh,* **Amiri,** *uh MEER ee* (1934-), is an African American author who gained fame for his powerful plays about race relations in the United States. His original name was Everett LeRoi Jones, and he first wrote under the name LeRoi Jones. In 1967, he changed his name to Imamu Ameer Baraka. During the 1970's, he altered this name to Amiri Baraka.

AP/Wide World

Amiri Baraka

Baraka first became known for three short, violent plays about racial conflict between blacks and whites. These plays—*The Slave, The Toilet,* and *Dutchman*—were all first presented in 1964. In *Dutchman,* Baraka warned blacks about the danger he saw in attempts to imitate white culture. He promoted black nationalism in several plays that reflected an extreme hatred of whites. The most praised of these plays was *Slave Ship* (1969), which deals with the transportation of black African slaves to the New World. During the 1970's, Baraka rejected black nationalism and wrote plays full of Marxist ideology.

Baraka has also written a novel, *The System of Dante's Hell* (1965). Many of his poems appear in *Transbluency: The Selected Poems of Amiri Baraka/LeRoi Jones (1961-1995),* published in 1995. He analyzed black music in America in *Blues People* (1963) and *Black Music* (1967). He also wrote *The Autobiography of LeRoi Jones/Amiri Baraka* (1984). Baraka was born in Newark, New Jersey. Don B. Wilmeth

Barbados, *bahr BAY dohz* or *bahr BAY duhs,* is an island country in the West Indies. The easternmost West Indian island, Barbados lies about 250 miles (402 kilometers) northeast of Venezuela. It is one of the most densely populated countries in the world.

The growing of sugar cane has been an important industry in Barbados for more than 300 years. Manufacturing and processing have steadily increased in importance. Barbados's pleasant climate and sandy beaches have made it a popular vacation resort. Tourism is also a major industry. Most of the country's people are blacks.

Barbados was a British colony from the 1620's until it became independent in 1966. Bridgetown is the capital and largest city. The city is the business and tourist center of Barbados. It is also the country's chief port.

Government. Barbados is a constitutional monarchy. A governor general represents the British Crown as head of state. But the prime minister and the Cabinet actually govern the country. The leader of the political party that has the most House of Assembly members serves as prime minister. Parliament consists of the Senate and House of Assembly. The governor general appoints the 21 senators, 12 of them on the advice of the prime minister. The people elect the 28 House of Assembly members. Members of Parliament serve for a maximum of five years. All citizens 18 years of age or older can vote.

WORLD BOOK maps

People. The way of life in Barbados is much like that in England. Traffic moves on the left, cricket is the most popular sport, and Bridgetown's harbor police wear uniforms that date from the late 1700's, the era of British naval hero Lord Nelson. All of the people speak English.

The people of Barbados are quiet, thrifty, and industrious. About 80 percent of the people are descendants of slaves brought to Barbados from Africa between 1636 and 1833, when slavery was abolished. More than 15 percent are of mixed African and British ancestry. About 4 percent are of European—chiefly British—descent.

Many of the people farm or work on sugar plantations. Many others have jobs in the tourist trade, the government, and other activities that provide services. Still others work in factories and processing plants, or on construction jobs. The Church of England is the largest church in Barbados. Other churches include the Roman Catholic, Methodist, and Moravian.

Popular foods include flyingfish, okra, pork, and yams. The people wear light, European-style clothing.

Barbados has a high literacy rate. Almost all Barbadi-

Facts in brief

Capital: Bridgetown.
Official language: English.
Area: 166 mi² (430 km²). *Greatest distances*—north-south, 21 mi (34 km); east-west, 14 mi (23 km). *Coastline*—56 mi (90 km).
Population: *Estimated 2002 population*—272,000; population density, 1,639 per mi² (633 per km²); distribution, 62 percent rural, 38 percent urban. *1990 census*—257,082.
Chief products: *Agriculture*—carrots, corn, milk, pork, sugar cane, sweet potatoes, yams. *Fishing*—flyingfish. *Manufacturing and processing*—chemicals, clothing, electronic products, sugar.
Flag: The two outer stripes are blue (for the sea and sky), and the center stripe is orange (for the sand of the beaches). A black trident head with a broken shaft is in the center. It stands for Neptune, the sea god, and for the change from dependence to independence. See **Flag** (picture: Flags of the Americas).
Money: *Basic unit*—Barbados dollar.

© Steve Vidler, Leo de Wys

Bridgetown, the capital of Barbados, is one of the West Indies' major trade and shipping centers. Interisland schooners can dock in the city's inner harbor, near the business district.

an adults can read and write. Children between the ages of 5 and 16 must attend school. Primary school and secondary school are free. Bridgetown has a branch of the University of the West Indies.

Land. Most of Barbados is flat, but a high, rugged region lies in the middle of the northeast coast. The land descends from the northeast coastal region across an upland plateau to a lowland plateau. The lowland plateau stretches to the coast all around the rest of the island. Fine sandy beaches stretch along the west and southwest coasts. Mount Hillaby (1,115 feet, or 340 meters) is the island's highest point. Almost all of the island is covered with coral rock, but 85 percent of the land can be farmed. Barbados has little natural plant life, but some evergreen trees grow in the northeast.

Temperatures range between 70 and 87 °F (21 and 31 °C). Rainfall varies from 80 inches (200 centimeters) a year in the north to between 40 and 60 inches (100 and 150 centimeters) in the south. Hurricanes occasionally cause extensive damage on the island.

Economy. Manufacturing and processing, tourism, and agriculture are all important to Barbados's economy. Factories make chemicals, clothing, and electronic products. Processing plants produce refined sugar from sugar cane and also make molasses and rum from it. Plants also produce edible oils, lard, and margarine.

Each year, thousands of tourists visit Barbados. They are attracted by its pleasant climate, good beaches, and English atmosphere.

Sugar cane is the country's chief agricultural product by far. Sugar was introduced about 1640. More than half of the land that can be farmed in Barbados is used to grow sugar. Most sugar is raised on large plantations. In May, at the peak of the sugar-harvesting season, most of Barbados's farmers work on the sugar plantations.

Farmers on small farms grow such food crops as carrots, corn, sweet potatoes, and yams. In addition, they raise pigs for meat, and cows for milk. Barbadians catch flyingfish and other fish for sale locally.

Barbados trades mainly with Canada, Japan, the United Kingdom, and the United States. It exports chemicals, clothing, electrical parts, molasses, rum, and sugar. It imports food, fuels, and manufactured goods.

Barbados has about 870 miles (1,400 kilometers) of paved roads, but there are no railroads. Bridgetown is the chief port of Barbados. The country's main airport is 12 miles (19 kilometers) from Bridgetown.

History. Scholars believe that Arawak Indians from South America were the first settlers in Barbados. They believe Carib Indians drove them out in the 1500's.

The English reached Barbados in 1625, and the first permanent English settlement was begun in 1627. From 1629 to 1652, several English families fought over Barbados. The British Parliament sent an expedition to gain control of the island in 1652. The colony had a governor and some representative government from the beginning. In 1639, the landowners of Barbados elected a House of Assembly. The colony prospered, and many English families settled there in the 1700's and 1800's.

In the late 1870's, Barbados opposed the British government's plans to form a federation of British islands in the West Indies. But Barbados joined the West Indies Federation when it was formed in 1958. Grantley Adams, a Barbadian, was the federation's prime minister. The federation broke up in 1962, when Jamaica and Trinidad and Tobago became independent. Barbados and several other West Indian islands tried to form another federation, but they could not agree on a constitution. Barbados gained independence from the United Kingdom on Nov. 30, 1966. In 1967, Barbados joined the Organization of American States (OAS). In 1968, it became a charter member of an economic union called the Caribbean Free Trade Association (CARIFTA).

From Barbados's independence in 1966 until 1976, the Democratic Labour Party (DLP) held a majority of the seats in the House of Assembly. DLP leader Errol W. Barrow served as prime minister. In 1976, the Labour Party won a majority of the seats. Labour Party leader J. M. G. Adams, son of Grantley Adams, became prime minister.

In 1983, Barbados and several other Caribbean nations joined the United States in an invasion of Grenada to overthrow a Marxist government there. See **Grenada** (History and government) for details.

Adams died in 1985 and was succeeded by Bernard St. John, the deputy prime minister. Parliamentary elections in 1986 returned the DLP to power. Barrow again became prime minister. He died in 1987 and was succeeded by the deputy prime minister, Erskine Sandiford. In elections held in 1994 and 1999, the Labour Party won a majority in the House of Assembly. Labour leader Owen Arthur served as prime minister.

Gustavo A. Antonini

See also **Bridgetown.**

Barbarian is a word used to describe an uncivilized or uncultivated person. It comes from the Greek word *bárbaros,* which at first meant simply a person who spoke a language the ancient Greeks could not understand. However, soon the word also came to mean *non-Greek* or *foreigner.* Later, the Romans applied the Latin word *barbarus* to such peoples as the Goths, Vandals, and Huns, who lived outside the Roman Empire. Many of these "barbarians" entered the empire either peacefully

or by force during the A.D. 300's and 400's, and contributed to its destruction.

When the Greeks began to colonize areas around the Mediterranean Sea about 750 B.C., they noticed cultural differences between themselves and other peoples. The Greeks considered their civilization superior to all others. Thus, they began to use the word *barbarian* in a disrespectful sense. The Greeks even considered the Egyptians and Persians cultural barbarians, because they did not cultivate the Greek ideals of civilized living. However, the Egyptian and Persian civilizations were older and in some ways more sophisticated than the Greek civilization.

After Alexander the Great conquered the Middle East (336-323 B.C.), the Greeks changed their attitudes toward foreigners. Many Middle Easterners adopted the Greek language, ideals, and ways of life. The label *barbarian* became restricted to those foreigners who had not absorbed Greek education or culture. This meaning was also used by the Romans, who adapted Greek culture and carried it throughout their empire.

In anthropology, the word *barbarian* may refer to groups of people that have achieved a settled agricultural life, but have no cities or art, and cannot read or write. William G. Sinnigen

See also **Goths; Hun; Vandals.**

Barbarossa. See **Frederick I** (Holy Roman emperor).

Barbarossa (1466?-1546) was a Barbary *corsair* (sea raider). Also called Khair-ed-Din, he was the younger of two red-bearded brothers who scourged the western Mediterranean in the 1500's. Khair-ed-Din succeeded his brother Arouj as commander of organized fleets of ships. He became high admiral of the Turkish navy, and devoted his life to ferocious and vengeful attacks on Christian ships and towns.

He also captured Tunis and Algiers. He plundered the shores of Italy, France, and Spain, and enslaved thousands of Christians. He twice defeated the great Genoese admiral, Andrea Doria. The Turkish naval supremacy that he helped build up was not destroyed until the Christians defeated the Turks at the Battle of Lepanto in 1571. Robert C. Ritchie

Barbary ape is the only wild monkey found in Europe. Barbary apes live on the Rock of Gibraltar which is located at the southern tip of Spain. They also live in remote areas of Morocco and Algeria in Africa. There are only about 5,000 Barbary apes left in the wild, most of them in Morocco.

The Barbary ape is not really an ape. It is related to the rhesus monkey of India and is more properly called the *Barbary macaque* (see **Macaque**). It was originally thought to be an ape because it lacks a tail.

The British government protects the Barbary apes living on Gibraltar. A legend says that the monkeys once warned the British of a surprise attack on Gibraltar by Spain. According to tradition, the British will never lose control of the Rock of Gibraltar as long as the apes live there. During the 1970's and 1980's, populations of wild Barbary apes were reduced, largely due to the destruction of their forest habitats.

Scientific classification. The Barbary ape belongs to the family of Old World monkeys, Cercopithecidae. Its scientific name is *Macaca sylvana.* Randall L. Susman

Barbary Coast. See **Barbary States.**

WORLD BOOK map

The Barbary States in the 1800's, shown in yellow, lay along the Mediterranean coast in North Africa.

Barbary States once lay along the coast of North Africa. This area is now part of Algeria, Libya, Morocco, and Tunisia. The terms *Barbary* and *Berber,* the name of the people who make up a large part of the north African population, come from the Latin word *barbari.* Barbari was the name given in Roman times to peoples who lived at the fringes of the Roman Empire.

From the early 1500's to the early 1800's, the Barbary States licensed *corsairs* (sea raiders) to attack the ships of other nations in the Mediterranean waters. From 1795 to 1801, the United States paid large sums of money to the Barbary States for protection against these corsairs.

© Tom McHugh, Photo Researchers

The Barbary ape is a tailless monkey, not a true ape. It lives in northern Africa and on the Rock of Gibraltar.

After Thomas Jefferson became president, the United States fought against Tripoli (1801-1805), and later against Algeria. In 1815, the Barbary rulers promised to stop the raids against United States ships.

During the 1800's and early 1900's, the Barbary States were ruled by France, Spain, and Italy. Algeria was made a part of France. Tunis became a protectorate of France. Most of Morocco became a protectorate of France except for a small part that was given to Spain. Tripoli became a part of Libya, which was an Italian colony. In 1943, Allied forces used Barbary ports as bases from which to invade southern Europe.

Libya gained independence in 1951. In 1956, Morocco and Tunisia followed. Algeria won its independence from France in 1962. Keith G. Mather

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Algeria
Barbarossa
Berbers
Decatur, Stephen
Libya
Morocco
Tunisia

Barbecue is a term that originally referred to the roasting of a whole hog, ox, or other large animal on a crude gridiron of stakes. The stakes were placed over hickory wood fires in an open field. The term *barbecue* now refers to any meat basted with or served in a barbecue sauce. The meat may be roasted slowly on a revolving spit, on a gridiron, over coals, under a full flame, or in an oven.

When charcoal grilling is done outdoors, steaks, chops, spareribs, chickens, hot dogs, hamburgers, or fish are cooked 4 to 5 inches (10 to 13 centimeters) above a bed of glowing coals. Before cooking, the meat may be soaked in a *marinade* (mixture) of vinegar, onion, garlic, salt, and spices for several hours. The meat is basted frequently with a barbecue sauce while being cooked. Most barbecue sauces have a tomato base and contain ingredients of the marinade.

Jane Ann Raymond Bowers

Barbed wire is steel wire with thornlike barbs at frequent intervals. It can be made of one wire or of two or more wires twisted together. It is used in fences, particularly for fencing in livestock.

When the American pioneers settled the prairies and plains, where wood was scarce, they planted shrubs to fence in their livestock. They used such shrubs as osage orange, which had thorns and grew thick enough to hold the animals. The invention of barbed wire was inspired by the thorned shrub. Joseph F. Glidden of De Kalb, Illinois, introduced the first commercially successful barbed wire in 1874. Cattle owners opposed the use of barbed wire because it enabled small farmers to fence in homesteads on government land. The cattle owners had been using this land for free pasturage. Barbed wire brought an end to the open range and made possible the settlement of the frontier by small farmers. Odie B. Faulk

Barber is a person who cuts or dresses the hair, and shaves or trims the beard, of other people. The term comes from a Latin word meaning *beard*. In early days, barbers also were surgeons. In England, the two professions were separated by an act passed during the reign of Henry VIII, who ruled during the 1500's. This act forbade barber-surgeons to do any surgical operation except bloodletting or toothdrawing. Today, little shaving is done in barber shops, because modern razors allow people to easily shave themselves.

The sign of the barber's profession is still widely kept. It is a pole with red and white stripes in a spiral around it. These stripes represent the bandage with which the barber wrapped the patient after bloodletting.

The barber's trade is ancient. Razors have been found among Bronze Age relics. According to legend, Alexander the Great made his soldiers shave regularly so that the enemy could not grasp their beards. Egyptian men had elaborate equipment to beautify the face and hair. Barbershops in Rome and Athens were places of discussion and gossip.

Barbers' schools teach the trade scientifically today. Courses include lectures on sanitation and the structure of the hair and scalp. The art of arranging and cutting hair is also called *hairdressing*. Most states require barbers to be licensed. In the United States, many barbers are organized into a labor union. Franz J. Singer

See also Hairdressing; Razor.

Barber, Samuel (1910-1981), was an American composer. Much of his music is somewhat romantic in character (see **Romanticism**). Barber won the 1958 Pulitzer Prize for music for his opera *Vanessa*. The American composer Gian Carlo Menotti wrote the *libretto* (words). Barber won the 1963 Pulitzer Prize for his *Piano Concerto No. 1* (1962). His other popular instrumental works include the overture to *The School for Scandal* (1933); *Capricorn Concerto* (1944) for flute, oboe, trumpet, and strings; and *Concerto for Cello and Orchestra* (1945). His major works for voice and orchestra include *Knoxville: Summer of 1915* (1947) and *Prayers for Kierkegaard* (1954).

Barber was born in West Chester, Pennsylvania. He first gained national attention in 1938 when Arturo Toscanini conducted his *First Essay for Orchestra* and *Adagio for Strings,* which became his most popular work. Richard Jackson

See also Menotti, Gian Carlo.

Barber of Seville. See **Opera** (The opera repertoire).

Barberry is the name of about 500 species of low, usually spiny shrubs with yellow wood. The two species best known in the United States are the *common barberry* and the *Japanese barberry.* Both have red leaves

© Giuseppe Mazza

The common barberry has saw-toothed leaves and clusters of berries. The fruit and leaves turn bright red in autumn.

and bright red fruit in autumn. The common barberry grows wild in the Eastern United States. People also use the common barberry in landscape gardening. The spring stage of *black stem rust* attacks this barberry. This fungus disease also causes great damage to wheat. For this reason the common barberry should never be planted in wheat-growing regions, as the disease may spread from the barberry bushes into the wheat fields. The spines of the barberry always grow in groups of three, and its berries appear in clusters.

The Japanese barberry is a popular garden plant which is not attacked by rust. It can easily be distinguished from the common barberry. The Japanese species grows more compactly. It bears its red berries either singly or in pairs, and it has spines that grow singly rather than in clusters. The berries of the Japanese barberry remain on the plant throughout the winter. The stems contain a yellow dye. The *wintergreen barberry* is a hardy evergreen.

Scientific classification. Barberries belong to the barberry family, Berberidaceae. They make up the genus *Berberis.* The common barberry is *B. vulgaris;* the Japanese is *B. thunbergii;* the wintergreen is *B. julianae.* Fred T. Davies, Jr.

See also **Mayapple; Oregon grape.**

Barbershop quartet singing is an American style of harmony using four voices. In barbershop music, the four voices form a complete four-part chord on almost every note. Groups usually sing *a cappella* (without instrumental accompaniment).

The parts in barbershop harmony are, from highest to lowest, *tenor, lead, baritone,* and *bass.* In most choral singing, the melody is sung by the highest voice. But in barbershop groups, the melody is sung by the lead, the second highest voice. The four singers listen carefully to each other, minutely adjusting the pitch of their voices to create perfect tuning on each chord. These small adjustments along with matched vowel sounds and proper balance of the four parts create the unique blend of voices that is the distinctive characteristic of barbershop singing. Choruses also sing barbershop harmonies. In choral singing, groups sing the four parts.

Barbershop music as it is sung today began in the late 1800's, and often centered in community barbershops. The term *barbershop harmony* became well known after the success of the song "Play That Barbershop Chord" in 1910. Barbershop quartets made many popular early recordings of songs and became a feature in vaudeville shows.

During its early history, barbershop singing was performed almost entirely by men. Today, both men and women participate. The Society for the Preservation and Encouragement of Barber Shop Quartet Singing in America (SPEBSQSA) is an international organization for male barbershop singing founded in 1938. Similar groups for women are Sweet Adelines, Inc. (1947) and Harmony Incorporated (1959).

Critically reviewed by the SPEBSQSA, Inc.

Barbirolli, *BAHR buh ROH lee,* **Sir John** (1899-1970), was a British symphony and opera conductor. He became famous for the craftsmanship and vigor of his performances and for his command of the melodic component in a work.

Barbirolli was born in London. He made his debut at the age of 11 as a cellist. When Barbirolli was in his 20's, his interests shifted from performing to conducting. He founded his own chamber orchestra in 1925. Barbirolli conducted operas at Covent Garden in London from 1927 to 1933. From 1933 to 1936, he served as conductor of the Scottish Orchestra in Glasgow. Barbirolli conducted the New York Philharmonic Orchestra from 1937 to 1942 and the Houston Symphony from 1961 to 1967. He was knighted in 1949. Martin Bernheimer

Barbiturate, *bahr BIHCH uh rayt,* or *bahr BIHCH uh riht,* is any of a group of drugs used to calm people or make them sleep. Barbiturates reduce the activity of the brain and the rest of the nervous system. Regular use causes *addiction* (physical and mental dependence). An overdose can cause death. In the United States, these powerful drugs can be obtained legally only with a doctor's prescription.

Barbiturates are made from barbituric acid. Barbiturates are usually sold in capsule or tablet form, but they are also available in powder or liquid form. Barbiturates vary in structure and strength, and in the duration of their effects.

The first barbiturate used in medicine was barbital. It appeared in 1903 under the trade name Veronal. The second, phenobarbital, was introduced in 1912 under the trade name Luminal. Today, physicians in the United States use more than 25 kinds of barbiturates.

Medical uses. Small doses of most barbiturates calm people, and larger doses help bring sleep. The barbiturates most used for these purposes include amobarbital (Amytal), pentobarbital (Nembutal), secobarbital (Seconal), and a variety of combinations. Surgeons use thiopental and a few other barbiturates as anesthetics. Phenobarbital and some other barbiturates with long-lasting effects are sometimes used to help prevent epileptic seizures.

Dangers of barbiturates. An overdose of a barbiturate can cause coma or even death. A person who has taken an overdose needs prompt medical attention. A physician should be called immediately. While waiting for the doctor, the patient—if conscious—should drink several glasses of milk or water and should be forced to vomit. Strong coffee or tea may also be given. If the patient is unconscious, the doctor may have to administer oxygen and injections of a *stimulant,* a drug that increases the activity of various organs. See **First aid** (Swallowed poisons).

Some people take large amounts of barbiturates to escape tension. Such doses produce intoxication similar to that caused by alcohol. Users' speech becomes slurred, and their coordination and judgment become poor. People who regularly take large doses of barbiturates develop an addiction. When addicted people try to stop using barbiturates, they suffer convulsions, body twitchings, and severe nervousness. Sudden withdrawal from the drugs can cause death. Addicts can end their dependence on barbiturates only by gradually reducing the amount they take. Barbara M. Bayer

See also **Drug abuse.**

Barbizon School, *BAHR buh zahn,* was the name of a group of French painters who settled in the village of Barbizon during the 1830's and 1840's. The village is about 35 miles (56 kilometers) south of Paris, near the forest of Fontainebleau.

The Barbizon painters had a strong feeling for the

Village in Berry (1846), an oil painting on canvas; Cincinnati Art Museum

A Barbizon painting by Théodore Rousseau portrays a gentle rural scene near the French village of Barbizon. The Barbizon painters used partial lighting and muted colors to create a mood of gentle beauty in their landscapes of forests, farms, and villages.

beauty of the simple aspects of nature. They avoided the panoramic views featured in earlier landscape painting, and portrayed scenes of forest glades, pastures, and peasants working in fields. The group admired the Dutch landscape painters of the 1600's and, like them, tried to create a mood of gentle beauty through the use of partial lighting and muted colors.

The principal Barbizon artists were Théodore Rousseau and Jean François Millet. The landscape painter Camille Corot did not live in Barbizon, but he was a friend of many in the group, and his art resembles theirs in many ways. Ann Friedman

Barbuda. See **Antigua and Barbuda**.

Barcarole, *BAHR kuh rohl,* also spelled *barcarolle,* is a musical term for the songs originally sung by gondoliers in Venice. The term comes from the Italian word *barca,* which means *boat* or *barge.* The term *barcarole* has come to be applied to many compositions written during the 1800's, usually in $\frac{6}{8}$ time. They were written not only for voice but also for piano and other instruments. Especially well-known barcaroles were written by Polish composer Frédéric Chopin and French composer Jacques Offenbach. Thomas W. Tunks

Barcelona, *BAHR suh LOH nuh* (pop. 1,625,542), is the most important manufacturing and trading city in Spain. It lies on the northeastern coast of the Iberian Peninsula, and has one of the few good harbors in the country. For location, see **Spain** (political map). Barcelona is the second largest city in Spain. Only Madrid has more people. Barcelona has been an educational center for years. It is also a center of shipping and industrial activity.

Manufactures in Barcelona include cotton, wool, and silk materials; paper; glass; leather; automobiles; and metal products. Ships leaving Barcelona carry wine, cork, fruit, and products of the city's factories. Ships sailing into the port of Barcelona bring foodstuffs, livestock, machinery, and raw materials.

Barcelona has a subway system, airport facilities, and modern buildings. High on a hill stands the cathedral of Barcelona, which was begun in the late 1200's. The University of Barcelona was founded in 1450. Tradition says that Christopher Columbus announced his discovery of the New World in the *Plaza del Rey,* a courtyard surrounded by medieval towers.

Historians believe that the ancient city of Barcelona was founded about 230 B.C. by the Carthaginian leader Hamilcar Barca. He named the city Barcino, after himself. In the 1100's, Barcelona became an important commercial and industrial city. From the 800's to the 1100's, Barcelona was governed by a succession of the counts of Barcelona. In 1137, Barcelona united with Aragon. As the

Eric Carle, Shostal

Barcelona, a major commercial and industrial center, lies on the Mediterranean coast of northeastern Spain. It has been an important European seaport for more than a thousand years.

capital of Catalonia, Barcelona came under French rule in 1640. Spain regained control of the city in 1652. From 1808 to 1814, during the Napoleonic Wars, the French again occupied Barcelona. Since then, it has been under Spanish control. In the 1800's, it developed into Spain's leading industrial city. In the mid-1800's, it was the site of many revolts against the Spanish monarchy.

Labor unrest led to violence in Barcelona during the early 1900's. The city was the seat of the Republican government for a time during the Spanish Civil War. In September 1962, flash floods killed about 450 people in the Barcelona area. About 400 other people were unaccounted for. It was the worst natural disaster in Spain's modern history. The 1992 Summer Olympic Games were held in Barcelona. Stanley G. Payne

See also **Hamilcar Barca**.

Bard was an ancient singer-poet. The best-known bards lived in such Celtic lands as Ireland, Scotland, and Wales during the Middle Ages. They were professional poets who sang about the nation's heroes, accomplishments, and customs. These bards generally accompanied themselves on a harp or other stringed instrument. They passed their material on from one bard to another and extensively used the poetic techniques of alliteration and internal rhyme. By the 1700's, the Celtic bards were no longer major cultural figures. The tradition of the bard today survives at folk festivals, such as the *eisteddfod* in Wales. The term *bard* is sometimes used to describe certain poets. Some folk singers and composers may be called bards. See also **Irish literature** (Early Irish literature); **Homer**; **Wales** (The arts). Paul B. Diehl

Bardeen, John (1908-1991), an American physicist, was the first person to win a Nobel Prize twice in the same field. With Walter Brattain and William Shockley, he received the 1956 Nobel Prize in physics for the invention of the transistor. He shared the 1972 Nobel Prize in physics with Leon N. Cooper and John Robert Schrieffer for their theory of *superconductivity*. Superconductivity is the ability of some substances to conduct electricity without resistance at extremely low temperatures. See **Superconductivity**. Bardeen was born on May 23, 1908, in Madison, Wisconsin. He graduated from the University of Wisconsin and Princeton University. He did his work on transistors at Bell Telephone Laboratories and at the University of Illinois. Spencer R. Weart

Barenboim, *BAIR ehn boym,* **Daniel** (1942-), is an Israeli conductor and pianist. As a pianist, he became noted for his performances of the music of Ludwig van Beethoven and Wolfgang Amadeus Mozart. He has played chamber music with such famous musicians as violinists Itzhak Perlman and Pinchas Zukerman. Barenboim has conducted such important orchestras as the New York Philharmonic and the London Symphony Orchestra. He served as music director of the Orchestre de Paris from 1975 to 1989. In 1991, Barenboim took over as music director of the Chicago Symphony Orchestra. In 1992, he also became general music director of the German State Opera in Berlin.

Jim Steere, Chicago Symphony Orchestra

Daniel Barenboim

Barenboim was born on Nov. 15, 1942, in Buenos Aires, Argentina. He made his piano debut at the age of 7. His family moved to Israel in 1952. During the next few years, he studied piano, violin, conducting, and music theory in Europe. In 1956, he graduated from the Santa Cecilia Academy in Rome, Italy. A year later, he made his United States debut as a pianist in Carnegie Hall in New York City. He has made many recordings, both as a conductor and as a pianist. John H. Baron

Barents, *BAR uhnts,* **Willem,** *WIHL uhm* (? -1597), was a Dutch navigator. In 1596, he and his crew were searching for a northeast passage to Asia when they reached the island group now called Svalbard. Later, their ship became icebound near the island of Novaya Zemlya, over 600 miles (970 kilometers) north of the Arctic Circle. As a result, Barents and his crew became the first Europeans to winter so far north. They built a comfortable house from the ship's timbers and killed polar bears and foxes for food. Barents died the next spring on the return journey. The Barents Sea bears his name. William Barr

Barents Sea, *BAR uhnts,* lies north of Norway and the European part of Russia. The islands of Svalbard and of Franz Josef Land shelter it from the Arctic Ocean (see **Arctic Ocean** [map]). The sea was named for Willem Barents, a Dutchman who explored it from 1594 to 1596. Warm waters from the North Cape Current keep a year-long shipping lane open along the coast to the Russian port of Murmansk. Three-fourths of the sea may freeze in winter. Commercial fishing crews catch cod, herring, and haddock in its waters. Osa E. Brand

Barge is a sturdy, flat-bottomed boat used to carry bulk cargo, such as cement, coal, logs, oil, sand, and sugar. Some barges are pushed or pulled by tugboats. Others

© Chuck O'Rear, Woodfin Camp, Inc.

Barge traffic is heavy on the Mississippi. Barges are gathered into units called *tows* and are pushed or pulled by tugboats.

are powered by their own engines. Some are made from the hulls of sailing ships or steamships. *Scows* and *lighters* are types of barges used chiefly in sheltered waters, such as harbors. A navy barge is a fancy motorboat used by high-ranking officers. Robert F. Beck

See also **Ship** (Dry bulk carriers).

Barge dog. See **Schipperke**.

Bari, *BAHR ee* (pop. 342,309), is a busy seaport on the southern Adriatic coast of Italy (see **Italy** [political map]). Bari is the capital of the Puglia (Apulia) region, one of Italy's political regions. Bari is a trade and manufacturing center. As early as the 400's B.C., Bari was an important town. It has been destroyed and rebuilt three times. Each year, thousands of pilgrims visit the Church of St. Nicholas, which was founded in 1087. The original Saint Nicholas is buried there. Anthony James Joes

Barite. See **Barium**.

Baritone, *BAIR uh tohn,* also spelled *barytone,* is a male voice ranging between the *tenor* (higher) voice and the *bass* (lower) voice. A singer having such a voice also is called a *baritone.* The baritone voice can cover about two octaves, from A-flat downward.

Barium, *BAIR ee uhm,* is a soft, heavy, silver-colored metal element. The metal itself has few uses outside the laboratory. But it combines easily with many other chemicals to form compounds with important industrial uses.

Barium carbonate ($BaCO_3$) is used in the manufacture of ceramics and special glass, and to purify certain chemical solutions. It is also an ingredient in clay *slurries* (watery muds) used in drilling oil wells. Chemical manufacturers often use barium carbonate as a raw material when making other barium compounds. Barium carbonate is poisonous, and so is any barium compound that dissolves in water. Barium titanate ($BaTiO_3$) is used in sonar detectors and other electrical equipment. Barium nitrate ($Ba[NO_3]_2$) makes signal flares burn with a green flame. Barium ferrite ($BaO{\cdot}6Fe_2O_3$) is used to make magnets.

Barium sulfate ($BaSO_4$) is an extremely insoluble barium compound that is not poisonous. Doctors use it in X-ray examinations of a patient's digestive system. The barium sulfate absorbs X rays to show an outline of the intestines on the developed film. Barium sulfate and zinc sulfide form *lithopone,* a white coloring matter for paint.

Barium is never found in a pure state because it combines so easily with other elements. Pure barium is obtained by passing an electric current through a *fused* (melted) barium compound, such as barium chloride ($BaCl_2$). A piece of barium metal quickly reacts with oxygen and water vapor in the air to form barium oxide. It must be stored under kerosene to keep it pure.

Barium is found most often as barium sulfate in the mineral *barite,* or *heavy spar.* It is also commonly found as barium carbonate in *witherite.*

The chemical symbol for barium is Ba. Barium's atomic number is 56 and its atomic weight is 137.33. It melts at 725 °C (1337 °F) and boils at 1140 °C (2084 °F). Its density is 3.5 grams per cubic centimeter at 20 °C. It was first isolated in 1808 by Sir Humphry Davy, an English chemist. Duward F. Shriver

See also **Element, Chemical; Titanium** (Uses).

Bark is the outer covering of most kinds of trees and shrubs. It protects the stem, roots, and branches from injury, insects, disease, and loss of water. Tissues in bark also carry sugar from the leaves to other parts of the plant.

Bark is made up of circular layers of tissues that lie outside the woody core of trees and shrubs. These tissues are divided into two parts, *inner bark* and *outer bark.* Tissues in the inner bark transport and store food. The outer bark serves as a protective covering for the plant.

Most trees and shrubs begin to develop bark during their first year. New layers of inner and outer bark form every year, and the bark gradually grows thicker.

Inner bark is composed of layers of living, growing tissues. These layers, from innermost to outermost, are the (1) phloem, (2) phelloderm, and (3) cork cambium, or phellogen.

Phloem consists primarily of *sieve tubes,* which conduct sugar down from the leaves. Bands of fibers may support these tubes. The phloem also includes certain other kinds of cells, including companion cells and ray cells. The phloem in mature woody plants is produced by tissue called the *cambium,* which lies between the wood and the bark. Cell division in the cambium produces new layers of wood and inner bark, and causes the stem of the plant to grow wider. As new phloem accumulates, it pushes the older phloem out and crushes it into the outer bark.

The phelloderm is a layer of food storage cells. It is produced by the cork cambium, which acts similarly to the cambium in the production of new tissues. The growth of new phloem stretches the phelloderm and the cork cambium until they break apart and die. New layers of phelloderm and cork cambium then develop to replace the dead tissues.

Outer bark consists chiefly of *cork,* a tough, dead tissue produced by the cork cambium. Patches of dead phloem occur throughout the outer bark of mature trees and shrubs. This dead phloem has been pushed out by the growth of new phloem.

Cork cells have thick walls that contain a waxy, waterproof substance called *suberin.* Suberin protects the plant from losing water and prevents gases from passing in and out. Gases enter and leave the stem through *lenticels,* which are round or oval blisters in the surface of the bark. In young stems, the outer bark is also marked by scars at points where buds and leaves were once attached.

Young trees and shrubs have a thin, smooth layer of cork. As the stem of the plant grows wider, this layer splits, and new cork cells develop beneath it. This process continues throughout the life of the plant and causes the outer bark to become rough and scaly. The outer bark of a few kinds of trees remains smooth because it stretches easily. Trees with smooth bark include beeches and birches.

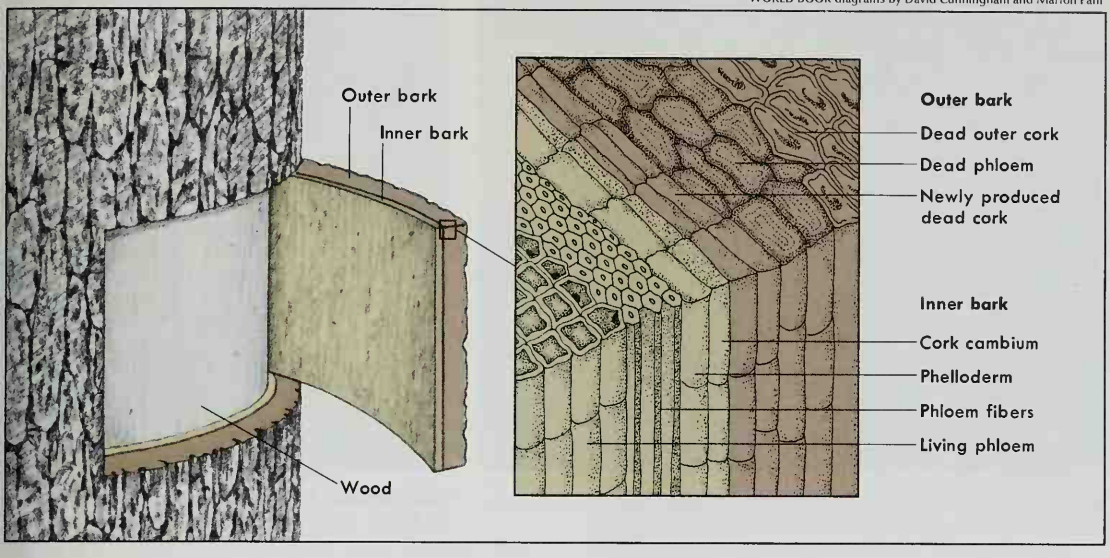
The cork cambium produces a new layer of cork annually. The thickness of the bark of most trees does not increase greatly because they lose some older bark each year. However, the outer bark of a large California redwood can measure more than 2 feet (61 centimeters) thick near its base. This thick outer bark protects the trees from damage caused by the heat of fire.

How people use bark. Early peoples used bark to make canoes, clothing, and shelters. The bark of many

The structure of bark

Bark consists of *inner bark* and *outer bark*. The tissues of inner bark transport and store food. Outer bark is dead tissue that serves as a protective covering. The diagram on the left shows bark as it appears on a tree. The diagram on the right is an enlarged view of the individual tissues.

WORLD BOOK diagrams by David Cunningham and Marion Pahl



kinds of trees has become commercially valuable through the years and is used in manufacturing a wide variety of products.

Manufacturers use cork from the extremely thick outer bark of the cork oak tree in making bottle stoppers, flooring, insulation materials, and many other products. The bark of certain trees contains tannic acid, a substance used in tanning hides to make leather. The bark of some tropical trees provides substances used in making chewing gum and rubber. Cherry cough medicine and cinnamon also are obtained from bark. Such fabrics as burlap and linen are made from phloem fibers. Richard C. Keating

Related articles in *World Book* include:

Cinchona	Lumber (picture: Removing the bark)	Tannic acid
Cinnamon		Tree (The parts of a tree; illustrations)
Cork	Stem	
Lenticel		

Bark beetle. See **Dutch elm disease.**

Barkerville. See **British Columbia** (Places to visit [Provincial parks]; picture).

Barkla, Charles. See **Nobel Prizes** (table: Nobel Prizes for physics—1917).

Barkley, Alben William (1877-1956), served as Vice President of the United States from 1949 to 1953 under President Harry S. Truman. As Vice President, Barkley showed great skill in presiding over the U.S. Senate. He enjoyed the personal confidence of Truman, and was known throughout the nation as *The Veep*. He was the first Vice President to sit on the National Security Council and to assist officially in formulating policy for the President's consideration.

Wide World

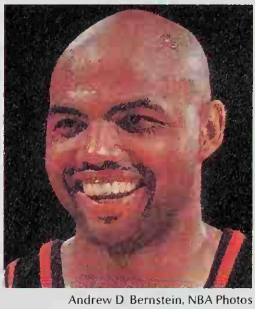
Alben W. Barkley

Barkley began his national political service in 1913 when he was elected as a Democrat from Kentucky to the U.S. House of Representatives. He served seven consecutive terms. From 1927 to 1949, he served in the U.S. Senate. He was Senate majority leader from 1937 to 1947 and minority leader from 1947 to 1949. After his vice presidency, Barkley was again elected senator from Kentucky in 1954, and served there until his death.

Barkley was born in Graves County, Kentucky. He was the son of a tenant farmer. Barkley worked to pay his way through Emory College in Georgia and the University of Virginia Law School. James I. Lengle

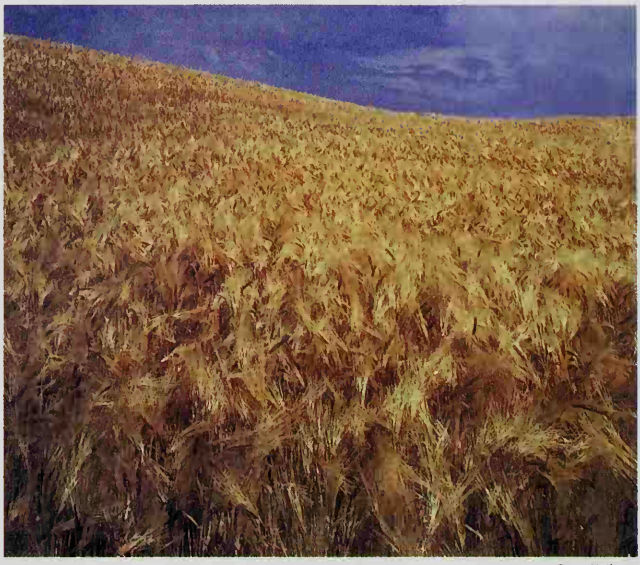
Barkley, Charles (1963-), became one of the leading scorers and rebounders in the National Basketball Association (NBA). Barkley's skill and intensity as a player and his outspoken personality have made him one of the best-known figures in American sports. Barkley, a forward, stands about 6 feet 5 inches (183 centimeters) tall. He was voted the Most Valuable Player in the NBA for the 1992-1993 season.

Charles Wade Barkley was born in Leeds, Alabama. He played for Auburn University from 1981 to 1984, when he was a first-round draft choice of the Philadelphia 76ers of the NBA. He led the NBA in rebounding for the 1986-1987 season and averaged over 20 points a game for most of his years in the league. He was traded to the Phoenix Suns after the 1991-1992 season. He



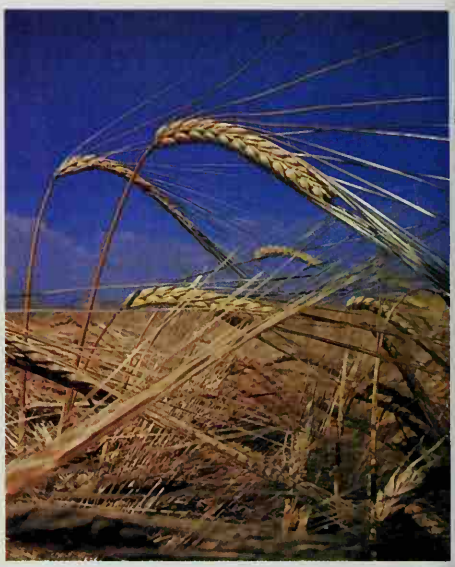
Andrew D. Bernstein, NBA Photos

Charles Barkley



Grant Heilman

Rippling fields of barley cover the countryside at harvesttime. Farmers grow barley mainly as feed for livestock.



Grant Heilman

Mature stalks of barley generally have bristles, or *beards,* growing out of the seeds.

was traded to the Houston Rockets after the 1995-1996 season. Barkley played on the United States teams that won the gold medal in men's basketball at the 1992 and 1996 Olympic Games. With Roy S. Johnson, he wrote an autobiography, *Outrageous! The Fine Life and Flagrant Good Times of Basketball's Irresistible Force* (1992). Barkley announced his retirement as a player in 1999 following a serious knee injury. William F. Reed

Barlach, Ernst Heinrich (1870-1938), was a German sculptor. He belonged to the expressionist movement in art that emerged in Germany during the years before World War I (1914-1918). See **Expressionism.**

Like many sculptors during the early 1900's, Barlach turned to past artistic styles as a way to create more visually powerful images. Barlach was particularly inspired by Russian folk carvings and wooden German sculpture from the Middle Ages. He carved the majority of his sculpture from wood, retaining the material's blocklike shapes and rough surfaces. Barlach's figures tend to display much emotion and are caught in a dramatic movement. Barlach's works are symbolic and tell a story.

Barlach was born on Jan. 2, 1870, in Wedel, near Hamburg. He was also well known as a printmaker and wrote plays and novels. Joseph F. Lamb

Barley is an important cereal grain. It belongs to the same family of plants as corn, oats, rice, and wheat. Farmers grow barley to provide grain for malting, and for feeding to livestock.

Barley plants resemble wheat. The seeds of the barley plant grow in spikes at the tips of the stems. Most common varieties of barley are *six-rowed* barleys, with single grains growing in groups of three on each side of the spike. *Two-rowed barleys* are less common. Many kinds of barley have *awns* or *beards* (bristles) growing from the husks that surround the seeds.

Cultivation. Barley will grow nearly anywhere in the Temperate Zone. It thrives in cool northern climates and at high altitudes. In warmer climates, farmers often cultivate it as a winter crop. Such *winter barley* is planted in the fall and harvested the following summer. *Spring barley* is planted in spring and matures by summer.

Farmers generally plant the seed in rows 6 to 7 inches (15 to 18 centimeters) apart and sow from 1 to 2 bushels of seed per acre (2.5 to 5 bushels per hectare). A bushel of barley weighs 48 pounds (22 kilograms). The grain is usually harvested with combines. But in some countries, farmers gather and thresh it by hand. The grain is har-

Leading barley-growing countries

Tons of barley produced in a year

Canada	14,467,000 tons (13,124,000 metric tons)
Germany	13,968,000 tons (12,672,000 metric tons)
Russia	12,370,000 tons (11,222,000 metric tons)
France	11,063,000 tons (10,036,000 metric tons)
Spain	10,881,000 tons (9,871,000 metric tons)
Turkey	8,304,000 tons (7,533,000 metric tons)
United States	7,602,000 tons (6,897,000 metric tons)
United Kingdom	7,239,000 tons (6,567,000 metric tons)
Ukraine	7,043,000 tons (6,389,000 metric tons)
Australia	5,922,000 tons (5,372,000 metric tons)

Figures are for a three-year average, 1998-2000.
Source: Food and Agriculture Organization of the United Nations.

vested when the kernels are almost dry. In most barleys, husks cover the threshed grain. However, varieties called *hull-less barley,* or *naked barley,* have kernels that thresh clean.

Annual world barley production totals about 145 million tons (130 million metric tons). Canada, Germany, and Russia rank among the leading barley-producing countries. In the United States, North Dakota, Montana, and Idaho produce the most. Alberta, Saskatchewan, and Manitoba lead the provinces of Canada in production.

Diseases and insect pests may reduce the yield and quality of barley. *Smuts* are fungi that change the kernels into powdery black masses of spores. *Stem rust* causes reddish or black patches on stems or leaves. *Mildew* appears as a cottony white growth on the plants. *Spot blotch* and *net blotch* cause lesions on leaves, stems, and roots. *Scab* leads to discoloration or black dots on the kernels. Viral diseases also strike barley and cause stunting, yellowing, or striping. Many barley diseases can be controlled by treating the barley seeds or foliage with chemicals and by using resistant or tolerant varieties. Grasshoppers, aphids, Hessian flies, and other insects also attack barley.

Uses of barley. In the United States, about 55 percent of the barley is used for animal feed. The grain is ground or rolled for use in mixed feeds, and the young plants provide hay, silage, and winter pasture.

High-quality barley is made into malt by sprouting the grain and then drying it. Malt is used in beer, liquor, malted milk, and flavorings. *Pot barley* is barley that has been ground enough to remove the husk. *Pearled barley* is ground in a revolving drum until the hull and germ are removed from the grain. This process reduces the grains to small starchy balls called *pearls.* Pearled barley is used for thickening soups. By-products of pearling include barley flour and animal feeds. Barley flour may be used in baby cereal and in bread.

History. Barley was probably one of the first cultivated cereals. Grains believed to be 5,000 to 7,000 years old have been found in Egypt and the Fertile Crescent region of the Middle East. Scientists are not certain where barley originated, but it may have been in Ethiopia, the Fertile Crescent, or central Asia. Robert D. Wych

Scientific classification. Barley belongs to the grass family, Poaceae or Gramineae. It is *Hordeum vulgare.*

See also **Brewing; Grain; Grass; Malt; Smut.**

Barlow's disease. See **Scurvy.**

Barn is a farm building that provides storage for crops, such as hay, grain, and vegetables, and shelter for animals and machinery. Barns are designed to promote the breeding, birth, and growth of animals, and to protect the health and safety of farmworkers. Barns may be insulated, ventilated, and equipped with heating and cooling systems. Some barns also have automatic systems to feed and water the animals and to remove wastes.

Farmers use general-purpose barns to store crops and to house livestock. There are also specialized barns designed for specific uses. For example, dairy barns house herds of milk cows. These barns have a facility called a *milking parlor* attached nearby. Most milking parlors include milking machines, a water supply, and a refrigerated storage tank.

Farmers may divide barns into spaces according to their use. Individual compartments called *stalls* are common in horse barns and some dairy barns. *Freestalls* enable animals to enter and leave the barn at any time to eat, drink, or exercise. Barns may have cribs for corn, lofts for hay, or bins for grain. Many dairy and beef barns have airtight bins or towers called *silos* next to them. Silos help preserve cut grasses and grains used to feed livestock during the winter (see **Silo**).

Grant Heilman

Barns serve many purposes on this dairy farm. They shelter cows at milking time and in bad weather, and also store feed.

Barns should be placed where there is some elevation or slope so that rain water can drain off. They should be at least 100 feet (30 meters) from homes and wells that supply drinking water. Martin L. Hellickson

See also **Dairying** (Housing).

Barn owl. See **Owl** (Important owls).

Barnabas, *BAHR nuh buhs,* was a Christian missionary during New Testament times. The apostles of Jesus Christ named him Barnabas, which meant *son of encouragement,* and he is known by this name throughout the New Testament. A Jewish priest from Cyprus, Barnabas was among the first Jews to be converted to Christianity by the apostles. He became an important and respected figure in Jerusalem's Christian community. He set an example of the radical attitude toward possessions that encouraged the early Christians to give what they had for the welfare of others.

Barnabas later went on a mission to Antioch, capital of the Roman province of Syria. In time, he became leader of the Christian community there. Saint Paul served as his assistant in this ministry. The Christians of Antioch sent Barnabas and Paul on the first Christian mission to Cyprus and Galatia. Barnabas later returned on a second mission to Cyprus. M. Robert Mulholland, Jr.

Barnacle, *BAHR nuh kuhl,* is the only crustacean that stays in one position during its adult life. *Crustaceans,* which include barnacles, lobsters, and shrimp, are a type of animal with a shell and jointed legs. Adult barnacles attach themselves to a hard surface, such as a rock, the hull of a ship, or even a whale. Because a build-up of barnacles can slow a ship, shipowners use toxic paint to keep the animals off hulls.

There are around 1,000 species of barnacles. These species are divided into two main groups, barnacles with stalks, called *goose barnacles,* and barnacles with-

© Bill Curtsinger, Photo Researchers

Barnacles attach themselves to hard surfaces and spend the rest of their lives in that position. These goose barnacles have fastened themselves to a *float* (a device used in fishing).

out stalks. Goose barnacles, often found on ships, grow to 30 inches (75 centimeters) in length. Stalkless barnacles range from $\frac{3}{5}$ inch to more than 3 inches (1.5 to 8 centimeters) in diameter.

Barnacles live in oceans throughout the world. Young barnacles go through a series of immature forms called *larval stages* that are different from the adult form. A barnacle hatches into a microscopic larva called a *nauplius*. The nauplius swims and drifts great distances, finally changing into a shelled, bean-shaped form called a *cypris*. The cypris settles out of the water onto a solid object, where it clings. The barnacle then sheds its larval shell and begins to form a set of hard, fixed plates.

A barnacle eats by extending its bristly *cirri* (tentacles) through the top of its shell. The animal waves them through the water to gather tiny organisms called *plankton* for its food. James T. Carlton

WORLD BOOK illustrations by Patricia Wynne

Two kinds of barnacles are the goose barnacle and the rock barnacle. In this illustration, both kinds have their *cirri* (feelers) extended. Barnacles use their cirri to capture food.

Scientific classification. Barnacles make up the class Cirripedia in the subphylum Crustacea of the phylum Arthropoda.

See also Crustacean.

Barnard, Christiaan Neethling (1922-2001), a South African surgeon, performed the first human heart transplant in history. On Dec. 3, 1967, he directed a 30-person medical team that performed the historic surgery in Cape Town, South Africa. The surgeons removed the healthy heart of a 25-year-old woman who had died after an automobile accident. They placed the heart in the chest of 55-year-old Louis Washkansky, whose own heart was damaged. Washkansky died of a lung infection 18 days later.

On Nov. 25, 1974, Barnard performed his 11th heart transplant. But in this operation, unlike earlier ones, Barnard did not remove the patient's damaged heart. He joined the implanted donor heart to the patient's heart, thereby providing a "double pump" for the circulatory system. This technique had never before been used with a human being, but it did not prove as useful as Barnard had hoped.

Barnard was born in Beaufort West, South Africa. He studied at the University of Cape Town Medical School and received advanced training in surgery at the University of Minnesota. He wrote books on health, medicine, and South Africa, and an autobiography, *Christiaan Barnard: One Life* (1970). Daniel J. Kevles

See also **Heart** (The first heart transplants and artificial hearts).

Barnard, Edward Emerson (1857-1923), an American astronomer, became famous for his skill as an observer. He studied at Vanderbilt University. In 1887, he joined the staff of the Lick Observatory at the University of California. There, he discovered the fifth satellite of Jupiter in 1892, and began a series of Milky Way and comet photographs. In 1895, Barnard joined the staff of the Yerkes Observatory in Wisconsin. His observations there led him to conclude that many starless spaces in the Milky Way are *dark nebulae*, consisting of clouds of dustlike particles. Barnard was born in Nashville, Tennessee. Michael J. Crowe

Barnard, Frederick Augustus Porter (1809-1889), was the American educator for whom Barnard College was named. He served as president of the University of Mississippi from 1856 to 1861. He became president of Columbia College of New York City in 1864 and served until his death. His efforts to make Columbia coeducational resulted in the founding of Barnard College, which opened six months after he died. Barnard was born in Sheffield, Massachusetts, and graduated from Yale. Glenn Smith

Barnburners were members of a group in the Democratic Party of the state of New York during the 1840's. The name came from a story about a farmer who burned down his barn to free it of rats. The Barnburners were accused of being willing to destroy the Democratic Party to achieve their own goals. They were followers of Martin Van Buren, who had served as President of the United States from 1837 to 1841. The Barnburners mainly wanted to stop the spread of slavery in the United States and to help Van Buren become President again.

During the Mexican War (1846–1848), the Barnburners supported legislation to prohibit slavery in new U.S. territories. But Congress defeated the legislation. When new lands were gained as a result of the war, the Barnburners' opposition to slavery grew. In 1848, the Democratic Party nominated Senator Lewis Cass of Michigan for President. The Barnburners split from the Democratic Party and joined the Free Soil Party, which nominated Van Buren for President. The split led to the election of Mexican War hero Zachary Taylor, the Whig Party candidate. Later, many Barnburners joined the Republican Party. James C. Curtis

See also Free Soil Party.

Barnegat Lighthouse. See New Jersey (Places to visit).

Barnstorming. See Airplane (The golden age).

Barnum, P. T. (1810-1891), was the most famous showman of his time. He presented such popular attractions as General Tom Thumb, a midget; Jenny Lind, a famous Swedish singer; and Jumbo, a giant elephant. Barnum also helped found the most famous circus in history, known today as the Ringling Brothers and Barnum & Bailey Circus. To promote his attractions, Barnum relied on colorful advertising and publicity stunts. He often used exaggeration and deception to create interest in his shows and exhibits.

Phineas Taylor Barnum was born in Bethel, Conn. He began his career as a showman in 1835 when he exhibited Joice Heth, an aged slave who claimed to have been George Washington's nurse. In late 1841, Barnum became proprietor of the American Museum in New York City. The museum offered exhibits, lectures, and plays, and became one of New York City's most famous attractions. The museum burned down in 1865 and Barnum reopened it the same year. It burned down again in 1868 and was never rebuilt.

In 1842, Barnum became the manager of Charles Sherwood Stratton, a midget whom Barnum renamed *General Tom Thumb.* From 1844 to 1847, Barnum toured Europe with Stratton, who created a sensation and made a fortune for Barnum. In 1850 and 1851, Jenny Lind made a triumphant concert tour of the United States under Barnum's management. Barnum imported the African elephant Jumbo for the circus from the London Zoo in 1882.

Barnum opened his circus in 1871, and later called it *The Greatest Show on Earth.* One of Barnum's partners, William Cameron Coup, pioneered in the use of railroad cars to move the circus from town to town. This practice revolutionized the circus business from its old horse-drawn wagon days. A later partner of Barnum's, James A. Bailey, built the circus into the show that the Ringling brothers bought in 1907, after Bailey's death.

Brown Bros.

P. T. Barnum

In addition to his activities as a showman, Barnum became active in politics. He was elected to the Connecticut legislature in 1865 and 1866, and served one term as mayor of Bridgeport, Connecticut, in 1875 and 1876. He was also a famous temperance lecturer and wrote *The Life of P. T. Barnum,* one of the most popular autobiographies in American history. Neil Harris

See also Stratton, Charles S.; Lind, Jenny.

Additional resources

Andronik, Catherine M. *Prince of Humbugs: A Life of P. T. Barnum.* Atheneum, 1994.
Barnum, Phineas T. *Barnum's Own Story.* Ed. by Waldo R. Browne. 1927. Reprint. Peter Smith, 1962.
Kunhardt, Philip B., Jr., and others. *P. T. Barnum.* Knopf, 1995.
Saxon, A. H. *P. T. Barnum.* Columbia Univ. Pr., 1989.

Barometer is an instrument that measures the pressure of the atmosphere. Weather forecasters use barometers to detect changes in air pressure. In most cases, such changes indicate that the weather will soon change. Barometers can also be used to measure altitude because air pressure decreases as altitude increases.

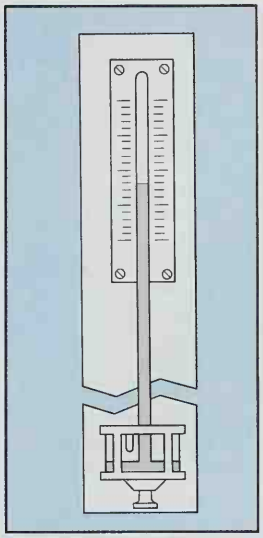
The barometer was invented by Evangelista Torricelli, an Italian physicist, who wrote a detailed description of the device in 1644. Torricelli's device consisted of a long glass tube filled with mercury and inverted in a cup of mercury. The column of mercury in the tube fell until its top was about 30 inches (76 centimeters) above the surface of the mercury in the cup. The pressure of the air on the surface of the liquid in the cup held the mercury in the tube. Torricelli thus showed that the pressure of the atmosphere roughly equals the weight of a 30-inch column of mercury.

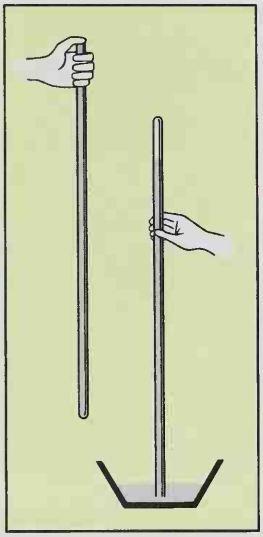
Modern barometers measure air pressure in inches or millimeters of mercury or in units called *bars* and *millibars.* The bar is a unit of pressure in the metric system, and a millibar equals $\frac{1}{1,000}$ bar. Scientists record most pressure measurements in millibars. The atmospheric pressure at sea level averages 1,013 millibars, which equals 29.92 inches (760 millimeters) of mercury. To compare measurements taken at various altitudes and temperatures, scientists first adjust them to the values that would be measured at sea level at 32 °F (0 °C).

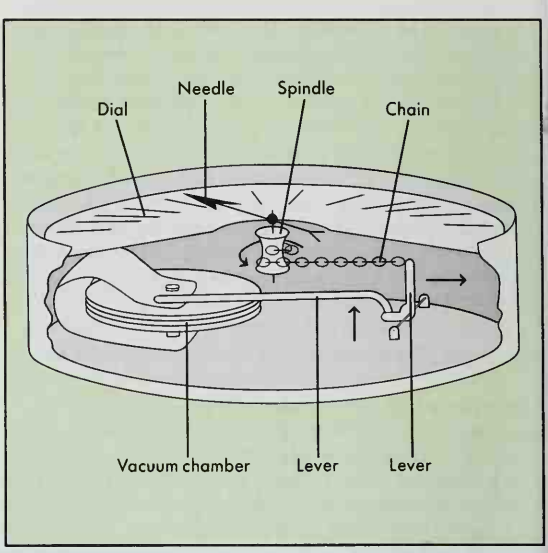
Kinds of barometers. There are two main types of barometers—*mercury* and *aneroid.*

Mercury barometers work on the same principle as Torricelli's device. A mercury barometer consists of a glass tube of mercury with a reservoir at the bottom. Changes in air pressure cause the mercury in the tube to rise and fall. A scale beside the tube indicates the pressure in millibars or in inches or millimeters of mercury. To get an accurate reading, the user must adjust the scale so that the zero point is even with the surface of the mercury in the reservoir. The adjustment is necessary because this surface rises when the mercury in the tube falls, and it falls when the mercury in the tube rises.

Aneroid barometers are less accurate than mercury barometers but are more sensitive to changes in air pressure. The word *aneroid* means *nonliquid,* which indicates that this type of barometer does not use mercury. An aneroid barometer measures the effect of air pressure on a metal chamber from which part of the air has been removed. Changes in air pressure make the chamber expand or contract, moving a needle on a dial. The dial may be scaled in millibars, inches, or millimeters. These light and portable barometers are widely







WORLD BOOK illustrations by Zorica Dabich

A mercury barometer works on the same principle as a tube-and-cup device described in 1644 by its inventor, the Italian physicist Evangelista Torricelli. Both devices consist of a glass tube of mercury inverted in a reservoir of mercury. Changes in air pressure cause the mercury in the tube to rise and fall. In the mercury barometer, a scale beside the tube shows the pressure.

An aneroid barometer has a vacuum chamber that expands or contracts with changes in air pressure. A drop in pressure causes the chamber to expand, *shown here.* The expansion causes a series of levers to pull on a chain that is connected to a spindle. The spindle turns counterclockwise and the needle attached to it moves to the left on the dial, showing the lower air pressure.

used in homes and schools, and on ships and airplanes.

Scientists use a type of aneroid barometer called a *barograph* to record changes in atmospheric pressure. A barograph includes a pen that records the air pressure on a paper chart mounted on a rotating drum.

Uses. In weather forecasting, the barometer's chief function is to determine the sea-level pressure and its change. A change in pressure usually means the weather will change. In general, cloudy weather occurs in low-pressure areas, and clear weather occurs in high-pressure areas.

The other major use of barometers is to measure altitude. Atmospheric pressure is lower at higher altitudes because the air there is thinner and has less air above to weigh it down. For example, the average air pressure drops from 1,013 millibars at sea level to about 700 millibars at an altitude of 10,000 feet (3,000 meters) and to about 300 millibars at 30,000 feet (9,100 meters). Pilots use a kind of barometer called a *pressure altimeter* to determine their altitude. Its scale shows altitude rather than pressure. Hikers and mountain climbers also may use barometers to measure altitude. David D. Houghton

See also **Altimeter; Weather; Isobar; Torricelli, Evangelista.**

Baron, *BAIR uhn,* is the title held by noblemen in the lowest rank in the British peerage. This rank was introduced into England after the Norman Conquest (1066). The king bestowed the rank on those to whom he granted land in return for military service. The barons were later divided into *greater* and *lesser* barons, according to the amount of land they held. The lands of these first barons were handed down from father to son, thus establishing the hereditary aristocracy.

The power of the barons grew with the years. The greater barons became earls or dukes, often with the lesser barons as their retainers. The wife of a baron or a woman who holds a barony is a baroness. A baron is addressed as "Lord," and a baroness is addressed as "Lady." Until 1999, the holder of a barony was entitled to a seat in the House of Lords.

The king or queen now confers the title of baron or baroness for distinguished service or distinction in art or letters, but the title is not hereditary. People who receive this honorary title are entitled to a seat in the House of Lords.

Baronet is a title taking rank between those of baron and knight. When in need of money in 1611, King James I decided to create the title of baronet and sell it to a number of people. The king's need of money was so great, however, that the limit was very elastic. The title is now conferred by the king or queen on anyone whom he or she wishes to honor. The title is hereditary and does not entitle the holder to a seat in the House of Lords. A baronet is addressed as "Sir." Ralph A. Griffiths

Baroque, *buh ROHK,* is a term applied to many forms of art created in western Europe and Latin America. The style first appeared in Rome in the late 1500's. Baroque art is large in scale and filled with dramatic details. In the 1700's, baroque art developed into a more relaxed, intimate style called *rococo* (see **Rococo**).

Three elements in the cultural life of western Europe helped form the baroque style. First, artists in the late 1500's rebelled against the art of the Renaissance. Renaissance art was restrained and orderly, and generally symmetrically balanced. Baroque painters, architects, and sculptors achieved balance in a more dramatic and exciting way. For example, a Renaissance architect might use rectangular areas to achieve balance and beauty. The more dramatic baroque architect would replace the rectangular areas with curved areas.

Second, many rulers wanted an art style that would glorify their reigns. Magnificent baroque palaces such as Versailles in France and the Zwinger in Germany expressed the power and authority held by the head of state.

Third, a movement called the Counter Reformation stirred a sense of religious enthusiasm in Europe during the late 1500's and the 1600's. Baroque churches expressed the drama and emotion of this movement.

Baroque architecture combined in new ways such classical and Renaissance elements as columns, arches, and capitals. Sweeping curved areas replaced orderly rectangular areas. Sculpture and painting played a greater part in building design, helping create an illusion of great space. Interest in the relationship between buildings and their surroundings led to greater emphasis on city planning and landscape design.

One of the highlights of baroque design was the creation of vast gardens, such as those at Versailles, the French king's country estate. There, nature was controlled and presented in a formal arrangement of cascades, fountains, terraces, and trees.

Baroque buildings in Austria, Spain, and Latin America were especially ornate and elaborate. Baroque architecture in France was more classical and ordered. Among the finest architects who designed buildings in the baroque style were the Italian artists Gian Lorenzo Bernini and Francesco Borromini. See **Architecture** (Baroque).

Baroque painting displays large-scale forms and often freely painted compositions. Artists developed new approaches to traditional subjects. Michelangelo da Caravaggio practiced a revolutionary style depicting earthy, realistic figures in close-up with dramatic contrasts of light and shade. Annibale Carracci established the Italian baroque taste for ceiling decoration of massive figures in settings that give the illusion of space. In Flanders in northern Europe, Peter Paul Rubens was the chief baroque artist. He painted large altarpieces, mythological subjects, and decorative compositions of weighty forms in dynamic movement. In Holland, Rembrandt was painting works that were often influenced by Caravaggio and Rubens. But Rembrandt used light effects and free application of paint for greater emotional and psychological insight. Spain's leading baroque painter was Diego Velázquez. His many portraits and other works have a somber, brooding quality. See **Painting** (The 1600's and 1700's).

Baroque sculpture was characterized by a tremendous feeling for movement. This came from the careful intermingling of mass and space as well as the use of new materials such as stucco and plaster. The greatest sculptor of the period was Gian Lorenzo Bernini of Italy. He worked primarily in marble, designing fountains, altarpieces, portrait busts, and free-standing pieces. All had remarkably realistic features and a flamboyant theatrical sense. See **Sculpture** (Sculpture from 1600 to 1900).

Baroque music, like other baroque art forms, is filled with complex details and contrasts. Baroque music was closely related to church and court life. Baroque religious music became increasingly dramatic and worldly. Opera, with its elaborate stage spectacles, first developed during the baroque period. The great baroque composers include Claudio Monteverdi and Alessandro Scarlatti of Italy, and Johann Sebastian Bach and George F. Handel of Germany. See **Classical music** (The baroque period). Eric M. Zafran

Additional resources

Argan, Giulio C. *The Baroque Age.* Rizzoli, 1989.
Earls, Irene. *Baroque Art: A Topical Dictionary.* Greenwood, 1996.
Kalnein, Wend von. *Architecture in France in the Eighteenth Century.* Yale, 1995.
Palisca, Claude V. *Baroque Music.* 3rd ed. Prentice Hall, 1991.

Barossa Valley, *bah ROH suh,* is one of Australia's main wine-producing areas. It is actually the valley of the North Para River, but the British explorer William Light named it *Barossa* (Hillside of Roses) after Barrosa, a wine-growing district in Spain. The valley lies about 35 miles (55 kilometers) east of Adelaide.

The Barossa Valley is sometimes called the *Valley of the Vine,* because of the extensive vineyards that cover the region's rolling hills. There are more than 25 wineries in the Barossa Valley, and each of the largest wineries has its own vineyard. The first vines were planted in the valley in 1847, and the first Barossa wine was produced in 1850.

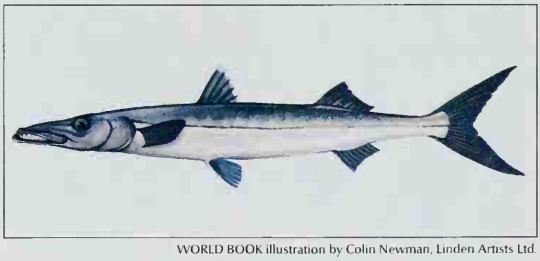
Many of the valley's inhabitants are descended from German settlers who first occupied the area during the 1840's. The valley was relatively isolated for many years, and the people spoke a mixture of German and English called *Barossa Deutsch.* Many buildings in the region have distinctive German architecture.

Barquisimeto, *BAHR kee see MAY toh* (pop. 602,622; met. area pop. 745,444), is one of Venezuela's largest cities. It is about 220 miles (354 kilometers) southwest of Caracas. For the location of Barquisimeto, see **Venezuela** (political map). The city serves as the trade center for a rich farm area where coffee, cacao, and sugar cane are grown. Products made in the city include fiber hammocks and bags. Jerry R. Williams

Barracuda, *BAIR uh KOO duh,* is the name of a family of marine fish with long, slender bodies and forked tail fins. Barracudas have large jaws and sharp teeth. They feed mainly on other fishes, but sometimes attack people.

There are 20 species of barracudas worldwide. Five species live off the Atlantic coast of North America, one off the Pacific coast, and two in waters off Hawaii. The *great barracuda,* found in the Atlantic, Indian, and western Pacific oceans, is the largest species of barracuda. It can grow to about 6 feet (1.8 meters) and 100 pounds (45 kilograms). The *great barracuda* is called the "tiger of the sea" because it is swift and destructive.

When young, great barracudas usually live close to



WORLD BOOK illustration by Colin Newman, Linden Artists Ltd.

Pacific barracuda

shore. They may form *schools* (groups) of up to several thousand. Adults are often found near coral reefs or artificial structures, such as oil rigs or sunken ships. They are generally solitary.

The *Pacific barracuda* may grow to a length of 4 feet (1.2 meters). It is found along the west coast of North America but is rare in waters north of California.

Eating the flesh of the barracuda often results in ciguatera, a disease that can be fatal. The disease is caused by a poison found in some marine plants. Barracudas become poisonous when they eat smaller fish that have fed on these plants. John D. McEachran

Scientific classification. Barracudas make up the barracuda family, Sphyraenidae. The great barracuda is *Sphyraena barracuda*. The Pacific barracuda is *S. argentea*.

See also **Fish** (picture: Fish of coastal waters and the open ocean).

Barrault, *bah ROH,* **Jean-Louis,** *zhahn LWEE* (1910-1994), was a French actor and director. He performed with the Comédie-Française, the French national theater, from 1940 to 1946. In 1946, Barrault and his wife, actress Madeleine Renaud, formed their own acting company in Paris, performing in classical French plays as well as modern French plays and translations. From 1959 to 1968, he directed France's second national theater, the Théâtre de France.

Barrault was born in Le Vésinet, a suburb of Paris. He made his motion-picture debut in 1935. His most famous film is *Children of Paradise* (1945). His other films include *La Symphonie Fantastique* (1942) and *La Ronde* (1950). Gerald M. Berkowitz

Barrel is a large, cylinder-shaped container made of wood or metal. The sides of a wooden barrel are made of *staves* (strips of wood), bound together by metal or wooden hoops. The staves are wider in the middle than at the ends, which makes a wooden barrel bulge in the middle. This shape increases strength, although it wastes space in shipment. The *heads* (top and bottom) of the barrel are flat wooden circles that fit into grooves near the ends of the staves. Barrels that hold liquids usually have a *bung* (hole). *Bung* also means the cork or plug used to fill the hole. A common use for wooden barrels is to store wine. Metal barrels, or drums, have a number of uses, especially in the storing and shipping of chemicals, paints, oils, and petroleum.

Skilled workers called *coopers* made barrels by hand for hundreds of years. Now barrel manufacturers use labor-saving machines, and *cooperage* (cask making) has become a large and important industry.

The barrel is a unit of measure for ale and beer in the United States. A U.S. beer barrel, which is also used for ale, holds 31 $\frac{1}{2}$ gallons (119 liters). In addition, the 42-gallon (159-liter) barrel is used as an international unit of commerce for petroleum. Leland F. Webb

Barrett, Elizabeth. See Browning, Elizabeth Barrett.

Barrie, J. M. (1860-1937), was a Scottish playwright and novelist. Barrie wrote more than 35 plays. His best-known play is *Peter Pan* (1904), a fantasy about a magical boy who refuses to grow up. For more information about the play, see **Peter Pan**.

Barrie's other plays are generally more realistic than *Peter Pan*. Several of them mix a satiric look at British society with open sentimentality. In *The Admirable Crichton* (1902), a group of upper-class English are shipwrecked on a desert island. They are helpless until their butler proves to be their leader. The play gently pokes fun at British attitudes toward social classes. In *What Every Woman Knows* (1908), the meek wife of a politician secretly guides her husband's successful career. Barrie's other plays include *Quality Street* (1901), *Alice Sit-by-the-Fire* (1905), *A Kiss for Cinderella* (1916), *Dear Brutus* (1917), and *Mary Rose* (1920).

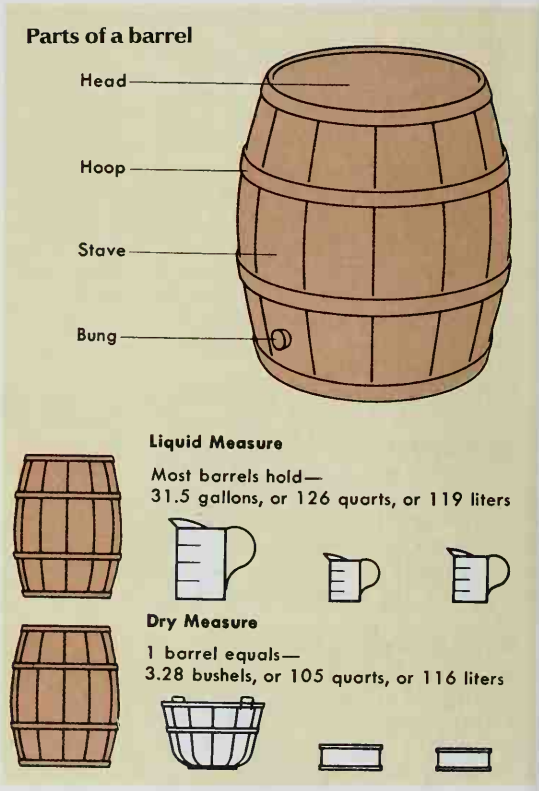
James Matthew Barrie was born in Kirriemuir, Scotland, the son of weavers. After completing his university studies in Scotland, he became a journalist in Nottingham and then in London. Barrie began writing novels in the 1880's. His first major success was *The Little Minister* (1891), a sentimental romantic novel about a shy preacher and the rebellious girl who marries him. Barrie also wrote *Sentimental Tommy* (1896), a novel about a young man with an overactive imagination. Barrie's first play was produced in 1891. A dramatized version of *The Little Minister* in 1897 made him rich and famous. The play's success enabled Barrie to give up journalism to devote himself to a literary career. King George V made Barrie a baronet in 1913, and he became known as Sir James Barrie. Gerald M. Berkowitz

Barrier reef. See Coral reef; Great Barrier Reef.

Barringer Crater. See Meteor Crater.

Barrios, *BAHR ryohs,* **Justo Rufino,** *HOOS toh roo FEE noh* (1835-1885), transformed Guatemala into a progressive nation. He became president in 1873 and ruled the country with an iron hand for more than 12 years.

Barrios was nicknamed the *Reformer*. He improved roads, built bridges, and established railroads, hospitals,



and a telegraph system in Guatemala. Barrios also reorganized the country's school system, founded colleges, introduced many laws, and settled a boundary dispute with Mexico. The great dream of Barrios's life was to form all the countries of Central America into a union. When he could not accomplish this by peaceful methods, he decided to use force. He was killed while leading his troops against those of El Salvador. He was born in Quezaltenango, Guatemala. John A. Booth

Barrister. See Lawyer.

Barron, James (1769-1851), a commodore in the United States Navy, became prominent during the critical period before the War of 1812. While commanding the *Chesapeake* in 1807, he was challenged by the captain of the British warship *Leopard.* The British captain demanded that he surrender several American sailors accused of deserting from the British navy. Barron refused, and the *Leopard's* guns fired on the *Chesapeake's* crew. Three of Barron's men were killed and 18 were wounded. Barron then surrendered the suspects. He was court-martialed, suspended from rank and pay for five years, and later placed on shore duty. Barron killed Commodore Stephen Decatur in 1820 in a duel in which he was seriously wounded (see **Decatur, Stephen**). Barron was born in Virginia. Michael J. Crawford

See also **War of 1812** (Impressment of seamen).

Barry, John (1745-1803), was an American naval officer in the Revolutionary War (1775-1783). He is one of several men referred to as the father of the American Navy. He became ranking captain of the first regular navy of the United States under the Constitution in 1794. Barry was born in Ireland. He settled in Philadelphia about 1760. When the Revolutionary War began, he became commander of the brig *Lexington.* He captured the British tender *Edward* in 1776. This was the first British warship taken in combat by a regularly commissioned American cruiser. John W. Ifkovic

Barry, Philip (1896-1949), was an American dramatist who had more than 20 plays produced on Broadway. He became known for his use of witty dialogue and social satire in such comedies of manners as *Holiday* (1928) and *The Philadelphia Story* (1939). These plays portray the sophisticated society of the 1920's and 1930's. They feature a wealthy young woman who rejects the materialistic conventions of upper-class society. Barry also wrote popular comedies about marital problems, notably *Paris Bound* (1927) and *The Animal Kingdom* (1932).

Barry wrote several impressive, sometimes puzzling, philosophical dramas. These works were less popular with critics and audiences than his comedies. *Hotel Universe* (1930) is a fantasy about spiritual values. *Here Come the Clowns* (1938) is Barry's dramatization of his only novel, *War in Heaven* (1938). It explores the conflict between good and evil.

Philip James Quinn Barry was born in Rochester, New York. He studied at Yale University, where he became a student in George Pierce Baker's famous "47 Workshop" for playwrights. Barry wrote *You and I* (1923), his first Broadway play, in the workshop. Barry's other plays include *The Youngest* (1924), *In a Garden* (1925), *White Wings* (1926), *The Joyous Season* (1934), *Liberty Jones* (1941),and *Without Love* (1942). Albert Wertheim

Barrymore is the family name of several noted American actors and actresses. The most famous members were the stage and motion-picture performers Lionel, Ethel, and John Barrymore. They were the children of actor Maurice Barrymore (1847-1905) and actress Georgianna Drew Barrymore (1856-1893). All three were born in Philadelphia. Georgianna's father was the Irish-born actor John Drew (1827-1862). Other performers in the family include Diana Barrymore (1921-1960), the daughter of John Barrymore; and Drew Barrymore (1975-), John's granddaughter.

Lionel Barrymore (1878-1954) first appeared on the stage in *The Road to Ruin* in 1893. He co-starred with his brother, John, in *Peter Ibbetson* in 1917 and *The Jest* in 1919. Lionel performed successfully in the theater until the 1920's. After a series of stage failures, he withdrew from the stage in 1925 and spent the rest of his career performing in motion pictures. He gained acclaim for such movies as *David Copperfield* (1935), *Captains Courageous* (1937), and the Dr. Kildare series, which started in 1938. He won the Academy Award for best performance by an actor in 1930-1931 for *A Free Soul.*

Ethel Barrymore (1879-1959) had her first major stage success in *Captain Jinks of the Horse Marines* in 1901. She had a long theater career, starring most notably as Miss Moffat in *The Corn Is Green* in 1940. Her many films include *The Spiral Staircase* (1946) and *Kind Lady* (1951). She won the 1944 Academy Award for best performance by an actress in a supporting role for *None But the Lonely Heart.*

John Barrymore (1882-1942) made his stage debut in 1903. He established himself as one of the outstanding actors of his generation in *Justice* in 1916, *Redemption* in 1918, *Richard III* in 1920, and *Hamlet* in 1922 and 1925. After *Hamlet,* he left the stage for a film career. Although Barrymore dissipated his talent in alcoholism, he made a number of highly praised screen appearances, notably in *Counselor-at-Law* (1933), *Twentieth Century* (1934), and *Romeo and Juliet* (1936). Daniel J. Watermeier

Additional resources

Kotsilibas-Davis, James. *The Barrymores.* Crown, 1981.
Morrison, Michael A. *John Barrymore, Shakespearean Actor.* Cambridge, 1997.
Peters, Margot. *The House of Barrymore.* 1990. Reprint. Knopf, 1991.

Phil Burchman

The three Barrymores, Lionel, Ethel, and John, *left to right,* appeared together in the film *Rasputin and the Empress.*

Barter is the direct exchange of goods or services without the use of money. Before the development of money, people used barter to get what they wanted. In the 1600's and 1700's, for example, trade between Europeans and West Africans was based on units of value called *sortings.* A sorting might consist of a barrel of palm oil, cloth for seven dresses, or a certain quantity of other goods. One sorting of cloth equaled one sorting of oil or anything else. The amount of goods in each sorting rose and fell according to supply and demand.

Barter also takes place where money is used. Today, hundreds of barter exchanges operate worldwide. They consist of people who wish to barter goods or services that they believe are equal in value. Many such groups have several hundred members. Members receive trade credits for the money value of the goods or services they offer. Large exchanges use computers to keep track of each member's trading account. By the late 1990's, many barter exchanges had Web sites. However, only a few exchanges offered online trading. Paul Bohannan

See also Money (How money developed); **Trading post.**

Barth, John (1930-), is one of the most experimental novelists in modern American literature. Barth has revolted against the realistic or formal novel. He favors a return to storytelling or mythmaking. Most of his works emphasize artificial literary devices to underscore that they are fiction, not a mirror of social reality.

Barth was born in Cambridge in eastern Maryland, the locale of much of his fiction. His early novels, *The Floating Opera* (1956) and *The End of the Road* (1958), are darkly humorous and embody what he considers the absurdity of life. His later works use parable, anecdote, parody, and satire, which give them a wildly comic flair.

Barth's best-known novel, *The Sot-Weed Factor* (1960), is written in the style of a novel of the 1700's. It punctures romantic views of history. *Giles Goat-Boy, or The Revised New Syllabus* (1966) is an elaborate parable of the computerized world represented as a university. *Lost in the Funhouse* (1968) and *On with the Story* (1996) are collections of stories. *Chimera* (1972) is a playful retelling of three legendary stories, including the first of several variations Barth wrote on tales from the *Arabian Nights.* His other novels include *Letters* (1979), *Sabbatical* (1982), *The Tidewater Tales* (1987), *The Last Voyage of Somebody the Sailor* (1991), and *Coming Soon!!!* (2001). Barth's nonfiction writings appear in *The Friday Book* (1984), and *Further Fridays* (1995). Victor A. Kramer

Barth, *bahrt,* **Karl** (1886-1968), was one of the best-known Protestant theologians of the 1900's. Barth was born in Basel, Switzerland. He was ordained a minister of the Swiss Reformed Church in 1909. From 1911 to 1921, Barth was a pastor in Safenwil, near Zurich. At that time, he was committed to the liberal theology of his day, based on the optimistic belief in the essential connectedness between God and humanity.

World War I (1914-1918) shattered Barth's liberal convictions. He rejected the idea that human beings could know the nature of God. He accused liberal theologians of forgetting the absolute distance between God and humans. In the second edition of his *Epistle to the Romans* (1922), Barth preached a theology of God's word in Jesus Christ as proclaimed by Saint Paul. He attacked the liberal Protestant belief that people could achieve religious understanding through their own reasoning. Barth conceived of God as "wholly other," speaking independent of any human actions or thought.

After World War I, Barth taught at the universities of Göttingen (1921-1925), Münster (1925-1930), Bonn (1930-1935), and Basel (1935-1962). He devoted the years from 1932 to 1962 to publishing *Church Dogmatics,* a monumental work in which he brilliantly reworked traditional church doctrines of God, creation, and Jesus Christ. In Barth's later theology, he argued his firm conviction that God loves human beings and freely chooses to express that love in their lives. David E. Klemm

Additional resources

Bromiley, Geoffrey W. *An Introduction to the Theology of Karl Barth.* 1979. Reprint. T. & T. Clark, 1990.

Hunsinger, George. *How to Read Karl Barth.* 1990. Reprint. Oxford, 1993.

Bartholdi, *bahr tawl DEE* or *bahr THAHL dee,* **Frédéric Auguste,** *fray day REEK oh GOOST* (1834-1904), was a French sculptor. He specialized in creating enormous patriotic sculptures glorifying French nationalism and friendship between France and the United States. His most famous work is the Statue of Liberty. For a discussion of Bartholdi's role in creating this monument, see **Statue of Liberty** (History).

Bartholdi was born in Colmar. In 1856, he joined the French painter Jean Léon Gérôme on a trip to Egypt. There Bartholdi was influenced by the colossal monuments of ancient Egypt. His other major works include *Lafayette* (1876) in New York City; the *Bartholdi Fountain* (1876) in the U.S. Botanical Gardens in Washington, D.C.; and the *Lion of Belfort* (1880), which sits on a hillside above Belfort, France. Douglas K. S. Hyland

Bartholomew, Saint, was one of the 12 apostles of Jesus Christ. He is listed among the apostles in the Gospels of Matthew, Mark, and Luke and in the Acts of the Apostles, but nowhere else in the New Testament. Bartholomew is sometimes thought to be Nathanael, a follower of Jesus mentioned in the Gospel of John. According to later Christian tradition, Bartholomew preached in India, Ethiopia, Persia, Asia Minor, and Armenia. He is also said to have written a Gospel. One report tells that Bartholomew was martyred in Armenia by *flaying* (having his skin stripped off). He is sometimes pictured as carrying his own skin. His feast day is August 24. See also **Apostles.** Richard A. Edwards

Bartlett, Edward Lewis (1904-1968), became one of the first United States senators from Alaska in 1959, the year Alaska became a state. He won reelection twice.

Bartlett, who preferred to be called E. L. (Bob) Bartlett, was born in Seattle. His family moved to the Alaskan mining town of Fairbanks when he was a year old. He often said that being born outside Alaska was his greatest regret. Bartlett worked as a newspaper reporter and as a gold miner. In 1944, he was elected as the territory's delegate to Congress. He strongly supported Alaskan statehood. A statue of Bartlett represents Alaska in the U.S. Capitol in Washington, D.C.

Bartlett, John (1820-1905), an American publisher, became known chiefly for the book *Familiar Quotations,* which is still published under his name. A notebook he kept for customers' convenience at his University Book Store in Cambridge, Massachusetts, developed into the

first edition of the *Quotations* in 1855. He was born in Plymouth, Massachusetts. Patricia A. Moody

Bartlett, Josiah (1729-1795), was a New Hampshire signer of the Declaration of Independence in 1776 and of the Articles of Confederation (the forerunner of the United States Constitution) in 1781. He served in the Second Continental Congress in 1775 and 1776 and again in 1778. He was a justice of the New Hampshire Superior Court from 1782 to 1790 and was chief justice of that court from 1788 to 1790. He then served as president (governor) of New Hampshire from 1790 to 1794. Bartlett was born in Amesbury, Massachusetts. Jack N. Rakove

Bartlett, Robert Abram (1875-1946), an Arctic explorer, was famous for his skill in piloting ships through ice. He commanded the *Roosevelt* for the explorer Robert E. Peary from 1905 to 1909, taking part in polar expeditions led by Peary (see **Peary, Robert E.**). Bartlett led an expedition in 1913 on which the ship *Karluk* was crushed by ice near Wrangel Island in the Arctic Ocean. He walked across the ice to Siberia and returned with rescuers for his companions.

Bartlett explored Alaska for air base sites in 1925. He served the United States government from 1942 to 1945. He made 20 Arctic voyages on his schooner *Morrissey.*

Bartlett was born at Brigus, Newfoundland. In 1911, he became a U.S. citizen. William Barr

Bartók, *BAHR tahk,* **Béla,** *BAY luh* (1881-1945), a Hungarian composer, was one of the most significant composers of the early 1900's. His compositions reflect his intense interest in folk music of Hungary and other areas of eastern Europe, as well as an interest in the established musical traditions of his time. Bartók's style emphasizes scales and harmonies of folk music, strongly dissonant harmonies, energetic rhythms, and creative use of both traditional and new forms.

Between 1908 and 1939, Bartók wrote six string quartets that show the full range of his musical style. They rank among the masterpieces of string quartet literature. His *Mikrokosmos* (1926-1939) is a collection of 153 piano pieces. It begins with simple pieces for beginners and ends with complex pieces suitable for concert performance. Bartók's other major piano works include *Allegro barbaro* (1911), a sonata (1926), and *Sonata for Two Pianos and Percussion* (1938). In addition, he wrote four concertos for piano and orchestra and several piano works based on folk songs and dances.

Bartók composed an outstanding *Violin Concerto* (1939) and wrote a collection of violin duets called *44 Duos* (1931). Bartók based the duos on folk music and intended them as teaching pieces. His major orchestral compositions include *Music for Strings, Percussion and Celesta* (1936) and his famous *Concerto for Orchestra* (1944). The concerto gives many instruments in the orchestra an opportunity to play solo passages and features the entire orchestra in a solo role. Bartók also wrote one opera, *Duke Bluebeard's Castle* (1918).

Bartók was born in Nagyszentmiklós, Hungary, now part of Romania. He studied piano and composition at the Hungarian Royal Academy of Music in Budapest. Bartók developed into an excellent pianist and made several concert tours starting in 1922. Early in his career, he began to collect and analyze folk music from Romania, Turkey, and Slovakia, and from Arab peoples of North Africa. He wrote several books and articles on folk music. In 1940, he moved to the United States, where he died. Daniel T. Politoske

Barton, Clara (1821-1912), was the founder of the American Red Cross. She was born in North Oxford, Massachusetts, and began her career as a teacher. She served as the first female clerk in the United States Patent Office (now the Patent and Trademark Office). Soon her humanitarian interests led her into the field of health.

After the outbreak of the American Civil War in 1861, Barton carried supplies to soldiers and nursed wounded men on the battlefields. Her deeds attracted national attention and appreciation. Barton was called the *Angel of the Battlefield.* At first, the United States government refused to give help or encouragement. But in 1864, she was appointed superintendent of nurses for the Army of the James. When the war ended, Barton formed a bureau to search for missing men. This bureau marked more than 12,000 graves in the Andersonville National Cemetery in Georgia.

The Red Cross. Barton's work during the Civil War left her exhausted and weak. In 1869, she went to Switzerland for a rest. There, she learned of the International Committee of the Red Cross, an organization based in Geneva. She took part in Red Cross activities at the battlefront during the Franco-Prussian War (1870-1871).

In 1873, Barton returned home. In 1877, prompted by the outbreak of war between Russia and Turkey, she started to convince people of the need to take an active part in Red Cross work. Her campaign resulted in the establishment of the American branch of the Red Cross in

Photo by Mathew B. Brady, American Red Cross

Clara Barton founded the American Red Cross in 1881. She also nursed the wounded at the battlefront during wars. Many people called her the *Angel of the Battlefield.*

1881. She became its first president and held that post from 1882 to 1904. She also urged the United States government to ratify the Geneva Convention, which the government did in 1882 (see **Geneva Conventions**).

Barton realized that the Red Cross could be useful to civilians as well as to soldiers. She originated the clause in the Red Cross constitution that provides for relief in calamities other than war. She took charge of relief work in the flood at Johnstown, Pennsylvania, in 1889, and the hurricane in the Sea Islands off the coast of Georgia and South Carolina in 1893. She also helped during the Russian and Armenian famines in 1891 and 1896.

Her other work. Barton wrote several books, including *The Red Cross* (1898) and *A Story of the Red Cross* (1904). After she retired in 1904, she lectured widely on topics related to the field of health. In 1906, she organized the National First Aid Association of America. Her 38-room house in Glen Echo, Maryland, which served as the headquarters for the American Red Cross for several years, became the Clara Barton National Historic Site in 1974. Kenneth R. Manning

See also **Red Cross** (In the United States).

Additional resources

Oates, Stephen B. *A Woman of Valor: Clara Barton and the Civil War.* Free Pr., 1994.
Pryor, Elizabeth B. *Clara Barton.* Univ. of Penn. Pr., 1987.
Tilton, Rafael. *Clara Barton.* Lucent Bks., 1995.
Whitelaw, Nancy. *Clara Barton.* Enslow, 1997. Younger readers.

Baruch, *buh ROOK,* **Bernard Mannes,** *behr NAHRD MAN uhs* (1870-1965), an American financier and statesman, served as an unpaid adviser to every president from Woodrow Wilson to Dwight D. Eisenhower. His most influential position was as chairman of the War Industries Board during World War I (1914-1918). He continued as an adviser to President Wilson during the peace negotiations. In 1934, President Franklin D. Roosevelt appointed Baruch chairman of a committee to suggest laws to mobilize the economy in the event of war. President Harry S. Truman appointed him United States representative to the United Nations Atomic Energy Commission in 1946. Baruch suggested a plan for UN inspection of atomic energy production.

Baruch was born on Aug. 19, 1870, in Camden, South Carolina. He moved to New York City in 1880, and graduated from City College of New York. He took various jobs, starting at $3 a week. He had a keen mind for finance and loved speculation. He joined a Wall Street firm and later bought a seat on the Stock Exchange. Baruch wrote two autobiographical works—*My Own Story* (1957) and *The Public Years* (1960).
William E. Pemberton

Barye, *bah REE,* **Antoine Louis,** *ahn TWAHN lwee* (1796-1875), was a French sculptor and painter famous for his bronze statues of animals. Barye's major works are noted for their precise and naturalistic anatomical figures of both animals and human beings. His bronzes of fierce lions and tigers in combat especially appealed to artists of the romantic movement of his day.

Barye was born in Paris on Sept. 24, 1796. He spent much time at the Paris zoo with his friend, the romantic painter Eugène Delacroix. At the zoo, Barye sketched the wild animals that became his subjects. Barye also painted numerous realistic landscapes of the countryside around the village of Fontainebleau. Ann Friedman

For an example of Barye's sculpture, see **Minotaur.**

Baryon, *BAR ee ahn,* is a unit of matter smaller than an atom composed of three still smaller particles called quarks. A baryon is one of two types of composite particles known as *hadrons.* The other type is called a *meson.* The name *baryon* comes from the Greek word for *heavy.* The lightest baryon, the proton, has a mass that is 1,836 times that of an electron. In general, the heavier the baryon, the more unstable it is—that is, the more rapidly it will *decay* (break down) into smaller particles.

The most familiar baryons include protons and neutrons. Protons and neutrons are called *nucleons* because they form an atom's nucleus. Protons are the lightest and most stable baryons. They will last at least a trillion trillion times the present age of the universe. Neutrons are heavier and less stable. The forces that bind neutrons to a nucleus can make neutrons stable. Freed from a nucleus, however, a neutron will decay into a proton and two other units called an *electron* and an *electron-antineutrino.* Free neutrons have an average life span of about 15 minutes before they decay.

There are many other types of baryons besides protons and neutrons, all heavier than the nucleons. Unlike nucleons, the heavier types do not occur naturally in atoms. Scientists create them in high-energy devices called *particle accelerators.* The heavier baryons are highly unstable, with average life spans shorter than one-billionth of a second. Most of these baryons contain heavy quarks, which quickly decay. It may take several decays to produce quarks that form nucleons. A powerful force called the *strong interaction* binds the quarks in baryons, as well as the nucleons in nuclei.

Scientists discovered the proton in 1919 and the neutron in 1932. They discovered the first unstable baryons in the early 1950's and have cataloged more than 100 varieties since. Robert H. March

See also **Neutron; Proton; Subatomic particle.**

Baryonyx, *bar ree AHN ihks,* was a large dinosaur that may have eaten mostly fish. It measured over 30 feet (9 meters) long and weighed about 2 tons (1.8 metric ton). The dinosaur walked on two powerful hind legs, using its long tail for balance. *Baryonyx*'s name means *heavy claw* or *strong claw.* This name describes large curved claws on the animal's thumbs that grew about 1 foot (0.3 meter) long.

The mouth of *Baryonyx* resembled that of a crocodile and contained numerous saw-edged teeth. When catching prey, the dinosaur may have crouched in shallow water and snatched passing fish with its mouth. Or it may have waded farther into the water to capture prey with its giant claws, much as a bear does. The animal's nostrils were set back from the tip of its snout, enabling it to breathe even when the end of its snout was under water. *Baryonyx* may also have scavenged for the meat of dead dinosaurs.

Baryonyx lived during the Early Cretaceous Period, about 125 million years ago. Scientists have discovered its remains in England. Fossils of *Baryonyx* claws were found detached from the dinosaur's skeleton, and it took scientists many years to learn where these claws appeared on the animal's body. Kenneth Carpenter

Baryshnikov, *bah RIHSH nih kahf,* **Mikhail** (1948-), is one of the world's leading ballet dancers. He performs in a style called *bravura,* which features bril-

Martha Swope

Mikhail Baryshnikov, who won fame for his brilliant and daring ballet dancing, performs a soaring leap in *The Nutcracker.*

liant, daring dancing. He is known for his highly developed technique and his fine character interpretations.

Baryshnikov was born on Jan. 28, 1948, in Riga, the Soviet Union. He began to study ballet at the age of 12. By the time he was 19, he was a soloist with the famous Kirov Ballet of Leningrad (now St. Petersburg). Baryshnikov defected to the West in 1974 and soon joined the American Ballet Theatre in New York City. He joined the New York City Ballet in 1978. He was artistic director of the American Ballet Theatre from 1980 to 1989.

Baryshnikov has danced principal roles in the standard ballet repertoire and in many modern works. He starred in several motion pictures, including *The Turning Point* (1977), *White Nights* (1985), and *Dancers* (1987). He has choreographed versions of *The Nutcracker* and *Don Quixote.* In 1990, Baryshnikov formed a touring company, the White Oak Dance Project, with choreographer Mark Morris. Katy Matheson

See also **Ballet** (Recent developments; picture).

Additional resources

Aria, Barbara. *Misha: The Mikhail Baryshnikov Story.* St. Martin's, 1989.

Glassman, Bruce. *Mikhail Baryshnikov.* Silver Burdett, 1990.

Townsend, Alecia C. *Mikhail Baryshnikov.* Rourke, 1993. Younger readers.

Barzun, *BAHR zuhn,* **Jacques,** *zhahk* (1907-), is an American educator and historian who has written widely on culture, education, and the history of ideas. From 1927 to 1975, he taught at Columbia University. He became noted for his imaginative teaching and polished lectures. He also served as provost and dean of faculties at Columbia from 1958 to 1967.

Barzun's *Teacher in America* (1945) won him an international following. He examined modern threats to the life of the mind in *The House of Intellect* (1959) and dealt with higher education in *The American University* (1968). In *From Dawn to Decadence* (2000), Barzun traced the history of Western cultural life from 1500 to 2000. His *Berlioz and the Romantic Century* (1950) analyzed the life, work, and influence of the French composer Hector Berlioz. Like his *Darwin, Marx, Wagner* (1941), the Berlioz book is distinguished for its artistic scholarship.

Jacques Martin Barzun was born on Nov. 30, 1907, in Créteil, France, near Paris. He came to the United States in 1920 and earned a Ph.D. degree from Columbia University in 1932. He became a U.S. citizen in 1933.

Gerald L. Gutek

Bas mitzvah. See Bat mitzvah.

Bas-relief. See Relief.

Basalt, *buh SAWLT* or *BAS awlt,* is a hard, dark volcanic rock. It is formed by lava that flows from volcanoes or from cracks in the earth, and hardens. There are many types of basalts. They all have similar chemical compositions, but they vary in crystallinity. They range from fine-grained rocks with uniform crystals to crystal-poor glasses. Basalt consists chiefly of two minerals, pyroxene and plagioclase feldspar.

Basalt is the most common volcanic rock in the earth's crust. The ocean floor is covered with basaltic lava that flowed from the mid-oceanic ridges. The Hawaiian Islands, Iceland, and other oceanic islands consist mostly of basalt. On the continents, large volumes of *flood basalts* make up such regions as the Columbia River and Snake River plateaus. Basalts also cover the dark lowlands of the moon, which are called *maria.*

Basaltic lava is extremely fluid and may flow long distances from its eruption site. When basalt erupts underwater, it forms rounded pillow-shaped lumps called *pillow lava.* When it erupts on land, its surface has either a smooth, ropelike texture, or a jagged angular one. Sometimes as basaltic lava cools, it splits into four-, five-, or six-sided columns. Cliffs of basalt columns, such as those along the Columbia River in Washington, are tourist attractions. Marilyn M. Lindstrom

See also **Igneous rock; Devils Postpile National Monument; Giant's Causeway.**

Basarwa. See San.

Base, in chemistry, commonly refers to any substance that can react with an acid to decrease or neutralize its acidic properties. A base is also called an *alkali.* When dissolved in water, bases feel slippery and taste bitter. Solutions of bases turn red litmus paper blue.

Chemists often define a base as any chemical compound that yields hydroxide ions (OH^-) when dissolved in water. For example, sodium hydroxide (NaOH), also known as *caustic soda* or *lye,* is a base that *dissociates* (breaks up) in water to form hydroxide ions and sodium ions (Na^+). The strength of such a base depends on the degree of dissociation. A strong base dissociates almost completely into ions. A weak base forms only a few ions. Strong bases, such as lye, can cause serious burns.

A base also may be defined as a chemical substance that readily combines with a proton. However, a base is most broadly defined as a substance that provides a pair of electrons to form a chemical bond. Under this definition, some chemicals that do not contain hydroxide ions are also classified as bases.

Bases have many practical uses. For example, many household drain cleaners contain sodium hydroxide, which can break down grease. Potassium hydroxide (KOH), also called *caustic potash,* is used in making soft soaps that dissolve easily in water. Magnesium hydroxide ($Mg(OH)_2$) is often used as an ingredient in antacids. It is also the main ingredient in milk of magnesia, a common laxative. Emily Jane Rose

See also **Alkali; Hydroxide; Neutralization.**

George Mars Cassidy, Van Cleve Photography

Baseball is often called the *national pastime of the United States.* Millions of Americans enjoy playing and watching this exciting "bat and ball" game.

Baseball

Baseball is a sport that is so popular in the United States that it is often called the *national pastime.* Every spring and summer, millions of people throughout the country play this exciting "bat and ball" game. Millions also watch baseball games and closely follow the progress of their favorite teams and players.

There are organized baseball teams for every age group from 6-year-olds to adults. The teams that attract the most interest are those of the two major leagues: the American League and the National League. These teams are made up of men who rank as the world's best players. Every year, about 50 million people flock to ballparks to watch major league baseball games. Many more millions watch games on television, listen to them on radio, read about them in newspapers, and discuss them with their friends.

Baseball began in the eastern United States in the mid-1800's. By the late 1800's, people throughout the country were playing the game. The National League was founded in 1876, and the American League in 1900. Through the years, baseball spread from the United States to other parts of the world. Today, it ranks as a major sport in such countries as Canada, Italy, Japan, Taiwan, the Netherlands, South Africa, and many Latin-American nations.

Baseball terms*

Balk is an illegal act by a pitcher with one or more runners on base. Runners advance one base on a balk. There are 13 ways to balk. For example, a balk occurs when a pitcher, with a foot on the pitcher's rubber, feints a throw to first base but does not throw.

Batting average shows the percentage of times that a player gets a base hit. To find a player's batting average, divide the number of hits by the number of official times the player has been at bat. Carry the answer to three decimal places.

Diamond is a nickname for the infield, used because the infield is shaped somewhat like a diamond. Sometimes, the term is used to mean the entire field.

Double play is a play on which the fielders put out two opponents. Most double plays result from ground balls hit in force situations. A *triple play* occurs when three outs are made on a single batted ball. This rare play usually takes place when a batter lines out to an infielder, catching two runners off base.

Earned-run average is the average number of *earned runs* scored against a pitcher every nine innings. An earned run is one that is scored without the aid of an error. To find a pitcher's earned-run average, divide the number of innings pitched by 9. Then, divide that total into the number of earned runs the pitcher allowed. Carry the answer to two decimal places.

Hit-and-run play occurs when a runner on first base runs toward second when the pitcher releases the ball. This forces the second baseman or shortstop to cover second base. The batter tries to hit the ball through the "hole" left open by the fielder.

Official scorer is an official of a baseball game who keeps a record of every play. In addition, the official scorer makes such decisions as whether a batter reached base as the result of a base hit or by a hit on error. Usually, a former newspaper sports reporter or a local sports official serves as the official scorer.

Runs batted in are runs scored as a result of a batter's base hits, outs (except double plays), sacrifices and sacrifice flies, walks, or being hit by a pitch.

Sacrifice occurs when a batter bunts a ball and is put out, but the play allows a base runner to advance. When a batter flies out and a runner scores from third base after the catch, it is a *sacrifice fly.*

Squeeze play calls for a batter to bunt the ball so that a runner can score from third base. If the runner waits to make sure the ball is bunted, the play is called a *safety squeeze.* If the runner advances before the batter attempts to bunt the ball, it is called a *suicide squeeze.*

*This table includes terms that do not appear in the text.

A baseball game is played on a large field between two teams of 9 or 10 players each. The teams take turns *at bat* (on offense) and *in the field* (on defense). A player of the team in the field, called the *pitcher,* throws a baseball toward a player of the team at bat, called the *batter.* The batter tries to hit the ball with a bat and drive it out of the reach of the players in the field. By hitting the ball, and in other ways, players can advance around the four bases that lie on the field. A player who does so scores a *run.* The team that scores the most runs wins the game.

The information in this section is based on the rules of major league baseball. Most other leagues follow much the same rules. The section on *Baseball leagues* later in this article lists some exceptions. For information on softball, a popular game based on baseball, see **Softball.**

Players and equipment

Players. National League baseball teams include nine players: a *pitcher, catcher, first baseman, second baseman, shortstop, third baseman, left fielder, center fielder,* and *right fielder.* Each player plays a defensive position when his team is in the field and takes a turn as the batter when his team is at bat.

American League teams include the same players, but they may—and almost always do—use a tenth player. This player, called the *designated hitter* (*dh*), bats in place of the pitcher. The dh does not play a defensive position. All other players except the dh and the pitcher both bat and play in the field. The American League adopted the designated hitter rule in 1973.

Baseball teams also have substitute players. A substitute may replace any player except the pitcher at any time. A pitcher must face at least one batter before leaving the game. A player who leaves a game for a substitute may not return to the game.

Other members of a baseball team include a *manager* and several *coaches.* The manager decides which players will play in the game and directs the team's strategy. The coaches assist the manager.

Equipment. A *baseball* is a small, hard, round ball. It measures from 9 to 9 $\frac{1}{4}$ inches (23 to 23.5 centimeters) in circumference and weighs between 5 and 5 $\frac{1}{4}$ ounces (142 and 148.8 grams). A tiny cork ball forms the center of the ball. Tightly wrapped layers of rubber and yarn surround the cork. Two strips of white cowhide sewn together with thick red thread cover the ball. Until 1974, the cover was made of horsehide, rather than cowhide. For this reason, baseballs are sometimes called *horsehides.*

A *baseball bat* is a long, rounded piece of wood. Most bats are made of ash wood, but some are made of hackberry or hickory. A major league baseball bat may not measure more than 42 inches (107 centimeters) long or 2 $\frac{3}{4}$ inches (7 centimeters) in diameter at its thickest point.

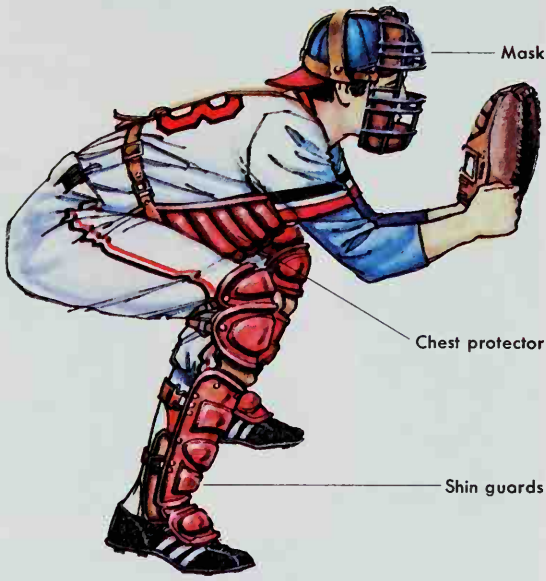
Each defensive player wears a padded leather *glove,* and uses it to catch the ball. There are three kinds of gloves: the *catcher's mitt,* which is worn by the catcher; the *first baseman's glove,* which is worn by the first baseman; and the *fielder's glove,* which is worn by all other players.

All players wear shoes with spikes on the soles so they can stop and start quickly. Most players wear shoes with metal spikes. But some wear shoes with synthetic rubber spikes when they play on fields covered by artificial turf. Players also wear uniforms, which include socks, knickers, a jersey, and a cap. The batter wears a special plastic cap called a *batting helmet.* The helmets are designed to avoid injuries to batters who are hit in the head with a ball.

A catcher wears special equipment for protection. A metal *mask* protects the catcher's face. A *chest protector*

The inside of a baseball has a cork center and layers of rubber and yarn. Strips of cowhide sewn together cover the ball.

The three kinds of baseball gloves are, *left to right,* the catcher's mitt, first baseman's glove, and fielder's glove.



The catcher wears special protective equipment—a metal mask, a padded chest protector, and plastic shin guards.

of padded cloth covers the catcher's chest and stomach. Plastic *shin guards* protect the catcher's legs.

The field

A baseball field includes three sections. They are (1) the infield, (2) the outfield, and (3) foul territory. The infield and outfield make up *fair territory*. Walls or fences surround the baseball field. The size and shape of the outfield and foul territory vary from ballpark to ballpark. However, the infield has the same size and shape in every ballpark.

A baseball field is covered partly by grass, or artificial turf, and partly by dirt. The diagram in this article shows a typical field. But some of the newest fields have artificial turf, rather than dirt, between the bases. A small, dirt sliding pit surrounds each base.

The infield is a square area with a base at each corner. The bases are—in counterclockwise order—*home plate, first base, second base,* and *third base*. Each base lies 90 feet (27.4 meters) from the next one.

Home plate is a slab of white rubber sunk into the ground so that its top is level with the ground. The front of the plate—the part that faces the rest of the infield—is 17 inches (43 centimeters) wide. The plate tapers off to a point in the back.

First base, second base, and third base are white canvas bags filled with *kapok* or some other soft material. Each bag is 15 inches (38 centimeters) square and from 3 to 5 inches (8 to 13 centimeters) thick. Spikes anchor the bags to the ground.

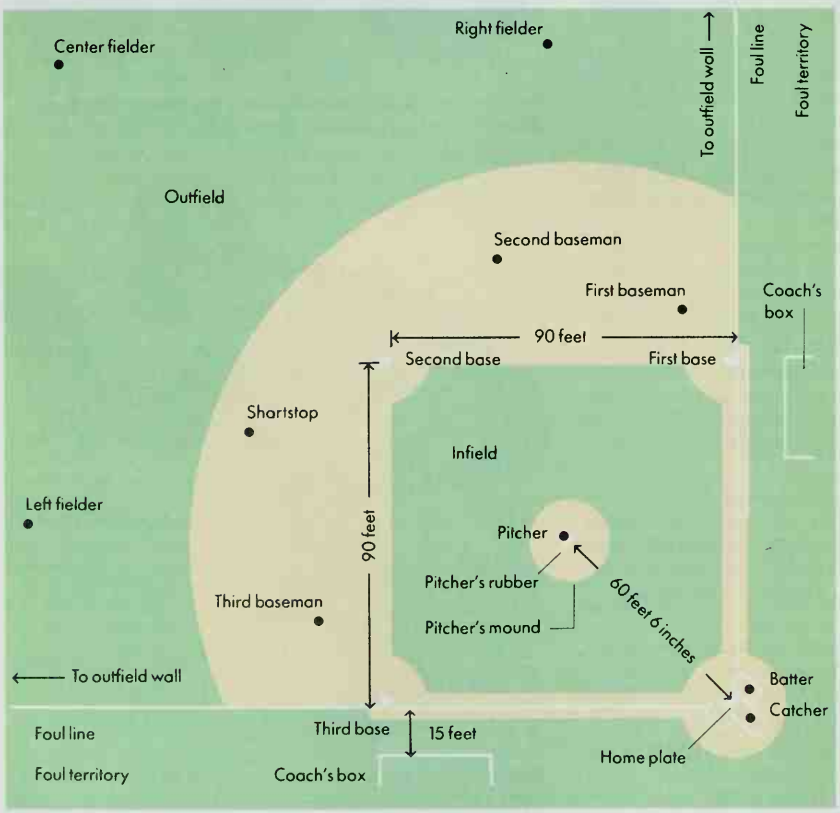
White lines made by chalk, lime, or some other material mark the boundaries of a *batter's box* on the left and right sides of home plate. Each box is 6 feet (1.8 meters) long and 4 feet (1.2 meters) wide. A *catcher's box* 5 feet (1.5 meters) long and 3 feet 7 inches (1.1 meters) wide lies behind the plate. Technically, the catcher's box lies in foul territory. But it is usually considered part of the infield.

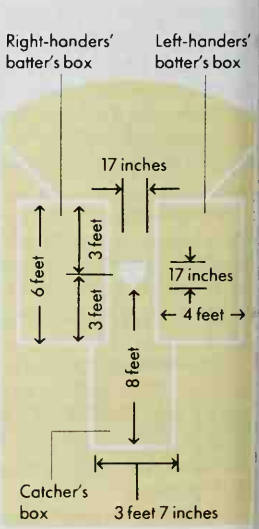
A straight white line called a *foul line* extends out from each side of home plate. These lines run past first and third base to the walls or fences at the end of the outfield. Each foul line is 3 inches (8 centimeters) wide.

A *pitcher's mound* rises near the center of the infield. The mound measures 18 feet (5.5 meters) in diameter and reaches a height of 10 inches (25 centimeters) at its center. A slab of white rubber called the *pitcher's rubber* is sunk into the ground at the center of the mound. The plate measures 24 inches (61 centimeters) by 6 inches (15 centimeters). It lies 60 feet 6 inches (18.4 meters) from home plate.

The outfield lies between the infield and the walls or fences farthest from home plate. Technically, the outfield begins directly behind first, second, and third base. But people usually think of the area just behind the bases as part of the infield. They consider the *grass line* the dividing point between the infield and the outfield.

Diagram of a baseball field





The diagram at the left shows a baseball field and the usual positions of the players. The outfield and foul territory extend beyond the area shown to the outer fences or walls. A detailed drawing of the home plate area appears below.

WORLD BOOK diagram

The grass line is the part of the field where the dirt beyond the bases ends and grass or artificial turf begins. In fields that have an artificial turf infield, a white line marks the location of the grass line.

The size of the outfield varies from field to field. But a major league rule sets minimum sizes. The rule requires that in ballparks opened before June 1, 1958, the outfield must be big enough so that the distance from home plate to the left and right field walls or fences at the foul lines is at least 250 feet (76.2 meters). The distance for ballparks opened after that date must be at least 325 feet (99.1 meters) down each foul line and at least 400 feet (121.9 meters) in center field.

Foul territory is the part of the field behind home plate and across the foul lines from the infield and the outfield. There is no standard size for foul territory. But the major league rule book recommends that the distance between home plate and the wall behind it be at least 60 feet (18.3 meters).

Two *dugouts*—one for each team—are built into the wall in foul territory. One lies behind first base, and the other behind third. Usually, the managers and other team members not required to be on the field sit in the dugouts.

White lines outline two *coach's boxes* in foul territory—one near first and one near third. The boxes measure 10 feet by 20 feet (3 by 6.1 meters).

An *on-deck circle* 5 feet (1.5 meters) in diameter lies between each dugout and home plate. The batter who follows the one at bat awaits a turn at bat in the circle nearest the dugout of the team at bat.

A field also includes a *bull pen* for each team. These areas have space where substitutes can *warm up* (practice) before entering the game. In some ballparks, the bull pens lie in foul territory across the foul lines from the outfield. In other parks, they are located beyond the outfield walls or fences.

Player positions. The pitcher of the team in the field stands on the pitcher's mound. The pitcher must have one foot in contact with the pitcher's plate when throwing the ball. The catcher crouches behind home plate, within the boundaries of the catcher's box. The catcher makes hand signals that tell the pitcher what kind of pitches to throw and catches balls that pass the batter. The pitcher and catcher are called the team's *battery.*

The first baseman and second baseman play between first and second base, and the shortstop and third baseman between second and third. These players, called *infielders,* try to catch balls hit short distances by batters.

The left fielder, center fielder, and right fielder spread out across the outfield. Called *outfielders,* these players try to catch balls hit past and over the heads of the infielders.

The batter of the team at bat stands in a batter's box. Left-handed batters stand in the box to the right of home plate. Right-handers stand in the box to the left of the plate.

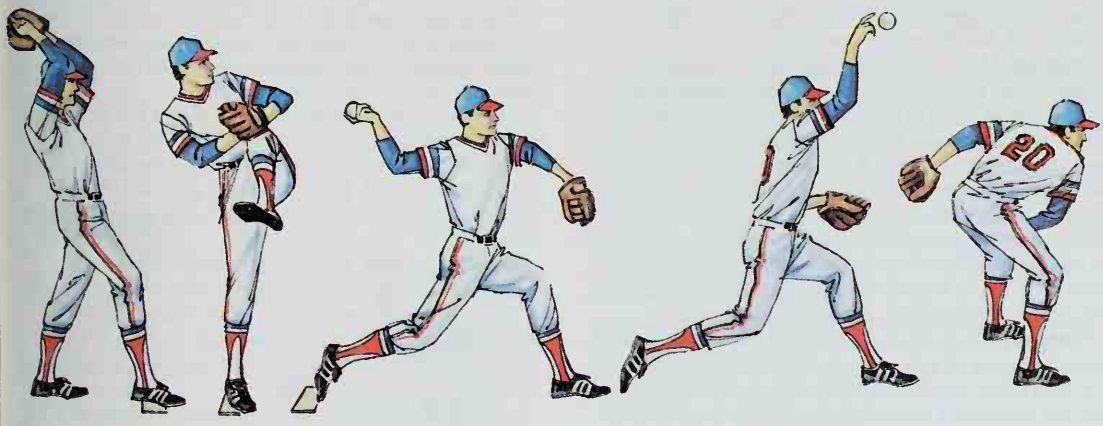
A coach of the team at bat stands in each coach's box. The coaches receive hand signals regarding strategy from the manager. They relay the signals to batters and base runners.

Umpires serve as the officials of baseball games. In most major league games, there are four umpires. One umpire stands near each base.

Baseball skills

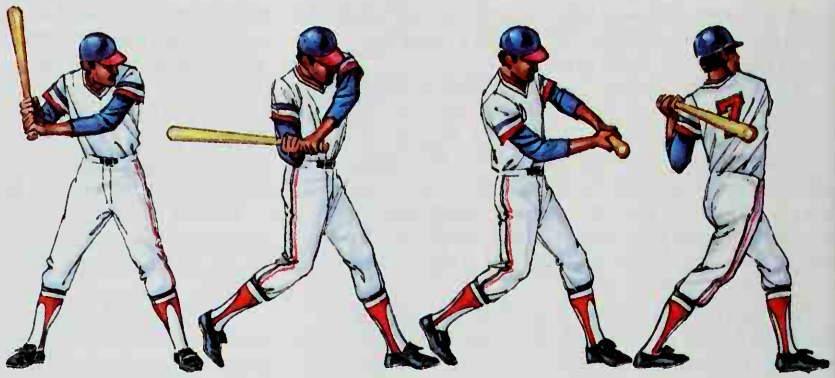
Basically, baseball matches the skills of the pitcher against those of the batter. But fielders and base runners also play key roles in the game.

Pitching. A good pitcher can throw a variety of pitches. The most common pitches are the *fast ball,* the *curve ball,* and the *slider.* A fast ball thrown by a major league pitcher may travel more than 90 miles (145 kilometers) per hour. A curve ball thrown by a right-handed pitcher breaks sharply to the left and downward as it reaches the batter. A left-hander's curve breaks to the right and downward. A slider looks like a curve ball. However, the slider seems to "slide" rather than break sharply, and it does not move downward. Other pitches include the *screwball,* which breaks just like—but in the



Pitching deliveries, or the ways pitchers throw the ball, vary widely. The series of pictures above shows a typical delivery of a right-handed pitcher. With the right foot on the pitcher's rubber, the pitcher (1) raises both hands above the head, (2) lifts the left leg, (3) pushes forward using the rubber for leverage, (4) releases the ball, and (5) follows through.

Focus on Sports



A good batting technique starts with a proper grip, *above left,* and a strong, even swing. The batter in the drawings above right plants his feet firmly and fixes his eyes straight ahead to prepare for the swing. He takes a level or fairly level swing and keeps his head still in order to follow the flight of the ball. Finally, he completes the swing with a smooth follow-through.

Focus on Sports

A batter bunts by tapping the ball a short distance into the infield. To bunt, a batter slides the upper hand up to about the middle of the bat, *above,* moves the feet to face the pitcher, *right,* and then lets the ball hit the bat.

opposite direction from—the curve ball; the *sinker,* which drops sharply as it reaches the batter; and the *knuckle ball,* which may break to the left or right, or downward. See **Bernoulli's principle.**

Batting. Many experts believe that a batter's job of hitting a ball thrown by a major league pitcher is the hardest thing to do in any sport. The ball reaches the batter in a fraction of a second. It may move in any of the ways described above as it reaches home plate. Even so, batters are able to follow the flight of the ball, whip the bat around quickly, and drive the ball sharply into the field. A batter may take a full swing and try to hit the ball as far and hard as possible. Or, a batter may take less than a full swing and try to poke the ball between fielders. This batting strategy is called *place hitting.*

Fielding. Good fielders can catch almost any ball hit near them and race far after balls and catch them. They can also throw the ball with great speed and accuracy to put out runners. A single outstanding play by a fielder can win a game for a team.

Base running. Good base runners can steal bases, and take an *extra base* (one more base than usual) on batted balls. They can quickly judge when to try to advance and when to stay near the base. A base runner, like a fielder, can win a baseball game with one outstanding play.

The game

Before a baseball game begins, the manager of each team makes a list that shows that team's *lineup* and *batting order.* A lineup tells which player will play each defensive position. A batting order shows the order in which the players will take their turns at bat.

The team on whose field the game is played is called the *home team.* The other team is the *visiting team.* The visiting team takes the first turn at bat and the home team players go to their positions in the field. The team's turn at bat lasts until its players make three *outs.* Every time a player advances around the bases during the turn at bat, the team is credited with a *run.* When the visiting team's turn at bat is over, the home team comes to bat and the visitors take the field.

One turn at bat by each team is called an *inning.* A regulation baseball game lasts nine innings. The team with the most runs at the end of the game wins. If the two teams have the same number of runs after nine innings, they play *extra innings* until one of them scores more runs than the other in an inning.

Each player who comes to bat during a baseball game tries to reach base and advance around the bases. The pitcher and other players of the team in the field try to put each batter out. There are many ways in which the players make outs, reach base, and advance around the bases.

Outs by batters. Most batters make outs in one of three ways—by strikeouts, ground outs, or fly outs.

Strikeouts. A batter strikes out by making three strikes during a turn at bat. There are four kinds of strikes—*swinging strikes, called strikes, foul strikes,* and *foul tips.*

A batter makes a swinging strike by swinging at a pitch and missing it. A called strike occurs when a batter *takes* (does not swing at) a pitch and the home plate umpire rules that the pitch was within the *strike zone.* A pitch within the strike zone is one that passes over any

part of home plate in a zone that extends from the midpoint between the shoulders and the belt to just below the batter's kneecap.

A batter makes a foul strike by hitting a *foul ball* when there are fewer than two strikes against the batter. Foul balls include all batted balls that: (1) settle in foul territory between home plate and first base or home plate and third base, (2) bounce or roll past first or third in foul territory, or (3) land in foul territory beyond first or third. Usually, a foul ball hit after two strikes does not count as a strike. But if the batter *bunts* (taps the ball) foul after two strikes, it does count as a strike.

A foul tip occurs when a batter hits a ball directly back to the catcher and the catcher catches the ball on the fly. All foul tips count as strikes, no matter how many strikes the batter already has.

Groundouts. A batter grounds out after hitting a *fair ball* that touches the ground by failing to reach first base before a fielder holding the ball touches the base or tags the batter with the ball. Fair balls include all batted balls that: (1) settle in fair territory between home plate and first base or home plate and third base, (2) bounce or roll past first or third in fair territory or hit either base, (3) land in fair territory beyond first or third, or (4) pass over an outfield wall or fence in fair territory. Almost all groundouts result from balls hit to infielders or the pitcher.

Fly-outs. A batter flies out after hitting a fair ball or foul ball if a fielder catches the ball on the fly. The foul tip, described earlier, is an exception to the fly out rule. Foul tips count as strikes, rather than outs.

Fly-outs hit short distances and high into the air are often called *pop-ups.* Those hit hard and on a fairly straight line are *line-outs.*

Other outs. There are several less common ways in which batters can make outs. For example, batters are out if they hit a fair ball and run into the ball, or if they bat out of turn and the opposing manager points out this violation to the home plate umpire.

Reaching base. Most batters reach base through *base hits.* A batter makes a base hit by (1) hitting a fair ball that is not caught on the fly, and (2) reaching first base before a fielder holding the ball touches the base or tags the batter with the ball. A batter who makes a base hit may continue to run around the bases. But if a fielder tags the batter with the ball while the batter is off base, the batter is out.

An infielder tags a base runner with a quick, sweeping motion. The runner slides to try to avoid the tag.

A base hit that enables a batter to reach first base is called a *single.* One on which a batter reaches second base is a *double,* third base a *triple,* and home plate a *home run.* Most singles result from balls hit into the infield or past the infielders but in front of the outfielders. Most doubles and triples are made on hits that get past outfielders. Almost all home runs result from batted balls hit over an outfield wall or fence. A batter who makes such a hit can simply trot around the bases, and cannot be tagged out.

A batter who hits a ball and reaches base because of a fielder's mistake is credited with a *hit on error,* rather than a base hit. One who reaches base because the fielders tried to put a base runner out is credited with a *fielder's choice.*

Batters can also reach base without hitting the ball. The most common way is to receive a *walk,* or *base on balls.* A batter walks if the pitcher throws four *balls* (pitches outside the strike zone) during that batter's turn at bat. A batter who walks goes to first base. A batter also goes to first base if the pitcher hits that batter with the ball. In addition, a batter goes to first on *catcher interference.* Catcher interference occurs when the catcher touches the bat when a batter is swinging.

Base runners—advancing and outs. A batter who reaches base becomes a base runner. Base runners try to advance around the bases and score runs for their team. The defensive players try to put the base runners out.

Base runners may try to advance at any time. But they usually wait until the batter hits the ball, and then decide whether or not to try to advance. If there are no outs or one out and a batter hits a ball that is likely to be caught on the fly, base runners stay near their bases. They do so because they must *tag up* (touch their bases) after a fly out. If a runner fails to tag up before a fielder holding the ball touches the runner's base or tags the runner with the ball, the runner is out. After tagging up, a runner can try to advance to the next base. The runner must reach the base before being tagged with the ball by a fielder, or else the runner is out.

When there are two outs, runners usually try to advance as soon as a fly ball is hit. They do so because their team's turn at bat ends as soon as a fielder catches the ball.

Base runners do not have to tag up if a batter hits a ball that touches the ground. But depending on the situation, runners may stay near their bases or run toward the next base on a ground ball. They stay near their bases if they judge that they will not be able to reach the next base before being tagged with the ball. This situation usually occurs on ground balls hit sharply to infielders. If runners believe they can get to the next base before being tagged, they run toward the base. They are out if they fail, and safe if they succeed.

In some situations—called *force situations*—base runners must try to advance to the next base. A force situation occurs when a batter hits a ground ball and a runner occupies a base another player is entitled to. A batter who hits a ground ball is always entitled to first base. As a result, a runner on first is forced to advance on a ground ball. If a team has runners on first and second base—or on first, second, and third base—all the runners are forced to advance on ground balls. In such

cases, each runner forces the runner on the next base. The runners make a *force-out* if they fail to reach the next base before a fielder with the ball touches the base. The fielder does not have to tag the runner in order to put the runner out.

Sometimes, base runners *run with the pitch*. That is, they race toward the next base as soon as the pitcher throws the ball. This strategy has both advantages and disadvantages. If the batter takes the pitch, and the runner gets to the next base before being tagged with the ball by a fielder, the runner is safe at the base. This play is called a *stolen base*. But if the runner fails to reach the base before being tagged, the runner is out. A runner who runs with the pitch can often advance farther on a hit than one who waits until the batter hits the ball. However, the runner risks being put out on a fly ball. Such a runner may end up so far from the base that it is impossible to get back to tag up before a fielder holding the ball touches the base.

Base runners can make outs and advance in other ways than those already described. For example, a runner is out if hit by a batted ball while in fair territory and not on a base. A runner on first base advances to second if the batter walks or is hit by a pitch. If the team also has a runner on second—or runners on second or third—those runners also move to the next base.

Umpires. Most major league games have four umpires. They are the *home plate umpire, first base umpire, second base umpire,* and *third base umpire*. The home plate umpire has the most important job. Every time a batter takes a pitch, the home plate umpire must decide whether it was a ball or a strike. This umpire also decides whether runners trying to reach home plate were safe or out. The first base umpire rules on plays at first base, the second base umpire on plays at second, and the third base umpire on plays at third. The first base and third base umpires also decide whether balls hit down the foul lines were fair or foul.

Baseball leagues

Many people play baseball on an informal basis. They get together with their friends, choose up sides, and play a ball game. But millions of people also play on a formal, organized basis. They join teams that belong to a league. The teams play regularly scheduled games against other teams in their league. The team with the best record at the end of the schedule, or the team that wins a play-off, becomes the league champion.

Baseball leagues range from those for players as young as 6 years old to leagues for adults. The adult leagues include the major leagues and the minor leagues. These leagues are professional leagues. Almost all other leagues are amateur leagues.

Major league and minor league teams consist entirely of men. Almost all players on most amateur teams are boys or men. But in the 1970's, many girls began demanding the right to play on boys' teams. Some teams now allow girls to join their teams.

Major leagues

There are two major baseball leagues, the American League and the National League. Both of the leagues consist of 14 teams. The teams in each league are divided into three divisions—East, Central, and West. Of the 28 teams that play in the major leagues, 26 of them are located in the United States, and the other 2 are located in Canada.

Regular season. Every major league team plays 162 games during the regular season. The major league season starts in early April and ends in late September or early October. During the regular season, each major league team plays all the other teams in its league. Teams in both leagues play half their games at home and half on the fields of their opponents. The teams that finish with the best record in each division win the division championships.

Play-offs. Four teams in each league qualify for play-offs after the regular season. They are the three division winners and the second-place team with the best record. In the first round of the play-offs, the second place team plays a division winner and the other two division winners play each other. The first team to win three games moves to the next round of play-offs. The first team in this round to win four games wins the *pennant* (becomes the league champion).

World Series. The American and National League pennant winners meet in the World Series. The first team to win four series games wins the world championship. The World Series is one of the world's major sports events. Played every year since 1903—except in 1904 and 1994—it captures the interest of millions of people. Many people who have only a small interest in baseball follow the series. TV and radio stations send play-by-play coverage of the series throughout the United States and to many other countries.

All-Star Game is a special game played during the regular season. It matches outstanding American League players against star players of the National League. Baseball fans choose the starting lineups—except the pitchers—for the two teams. The managers of the teams select the starting pitchers and all substitutes.

Minor leagues

Minor leagues serve as training grounds for major league baseball players. Most minor league teams are

Major league baseball teams

American League		
East Division	**Central Division**	**West Division**
Baltimore Orioles	Chicago White Sox	Anaheim Angels
Boston Red Sox	Cleveland Indians	Oakland Athletics
New York Yankees	Detroit Tigers	Seattle Mariners
Tampa Bay Devil Rays	Kansas City Royals	Texas Rangers
Toronto Blue Jays	Minnesota Twins	

National League		
East Division	**Central Division**	**West Division**
Atlanta Braves	Chicago Cubs	Arizona Diamondbacks
Florida Marlins	Cincinnati Reds	Colorado Rockies
Montreal Expos	Houston Astros	Los Angeles Dodgers
New York Mets	Milwaukee Brewers	San Diego Padres
Philadelphia Phillies	Pittsburgh Pirates	San Francisco Giants
	St. Louis Cardinals	

The World Series

Year	Winner	Loser	Games won-lost	Year	Winner	Loser	Games won-lost
1903	Boston (AL)*	Pittsburgh (NL)†	5-3	1953	New York (AL)	Brooklyn (NL)	4-2
1904	Not held			1954	New York (NL)	Cleveland (AL)	4-0
1905	New York (NL)	Philadelphia (AL)	4-1	1955	Brooklyn (NL)	New York (AL)	4-3
1906	Chicago (AL)	Chicago (NL)	4-2	1956	New York (AL)	Brooklyn (NL)	4-3
1907	**Chicago (NL)	Detroit (AL)	4-0	1957	Milwaukee (NL)	New York (AL)	4-3
1908	Chicago (NL)	Detroit (AL)	4-1	1958	New York (AL)	Milwaukee (NL)	4-3
1909	Pittsburgh (NL)	Detroit (AL)	4-3	1959	Los Angeles (NL)	Chicago (AL)	4-2
1910	Philadelphia (AL)	Chicago (NL)	4-1	1960	Pittsburgh (NL)	New York (AL)	4-3
1911	Philadelphia (AL)	New York (NL)	4-2	1961	New York (AL)	Cincinnati (NL)	4-1
1912	**Boston (AL)	New York (NL)	4-3	1962	New York (AL)	San Francisco (NL)	4-3
1913	Philadelphia (AL)	New York (NL)	4-1	1963	Los Angeles (NL)	New York (AL)	4-0
1914	Boston (NL)	Philadelphia (AL)	4-0	1964	St. Louis (NL)	New York (AL)	4-3
1915	Boston (AL)	Philadelphia (NL)	4-1	1965	Los Angeles (NL)	Minnesota (AL)	4-3
1916	Boston (AL)	Brooklyn (NL)	4-1	1966	Baltimore (AL)	Los Angeles (NL)	4-0
1917	Chicago (AL)	New York (NL)	4-2	1967	St. Louis (NL)	Boston (AL)	4-3
1918	Boston (AL)	Chicago (NL)	4-2	1968	Detroit (AL)	St. Louis (NL)	4-3
1919	Cincinnati (NL)	Chicago (AL)	5-3	1969	New York (NL)	Baltimore (AL)	4-1
1920	Cleveland (AL)	Brooklyn (NL)	5-2	1970	Baltimore (AL)	Cincinnati (NL)	4-1
1921	New York (NL)	New York (AL)	5-3	1971	Pittsburgh (NL)	Baltimore (AL)	4-3
1922	**New York (NL)	New York (AL)	4-0	1972	Oakland (AL)	Cincinnati (NL)	4-3
1923	New York (AL)	New York (NL)	4-2	1973	Oakland (AL)	New York (NL)	4-3
1924	Washington (AL)	New York (NL)	4-3	1974	Oakland (AL)	Los Angeles (NL)	4-1
1925	Pittsburgh (NL)	Washington (AL)	4-3	1975	Cincinnati (NL)	Boston (AL)	4-3
1926	St. Louis (NL)	New York (AL)	4-3	1976	Cincinnati (NL)	New York (AL)	4-0
1927	New York (AL)	Pittsburgh (NL)	4-0	1977	New York (AL)	Los Angeles (NL)	4-2
1928	New York (AL)	St. Louis (NL)	4-0	1978	New York (AL)	Los Angeles (NL)	4-2
1929	Philadelphia (AL)	Chicago (NL)	4-1	1979	Pittsburgh (NL)	Baltimore (AL)	4-3
1930	Philadelphia (AL)	St. Louis (NL)	4-2	1980	Philadelphia (NL)	Kansas City (AL)	4-2
1931	St. Louis (NL)	Philadelphia (AL)	4-3	1981	Los Angeles (NL)	New York (AL)	4-2
1932	New York (AL)	Chicago (NL)	4-0	1982	St. Louis (NL)	Milwaukee (AL)	4-3
1933	New York (NL)	Washington (AL)	4-1	1983	Baltimore (AL)	Philadelphia (NL)	4-1
1934	St. Louis (NL)	Detroit (AL)	4-3	1984	Detroit (AL)	San Diego (NL)	4-1
1935	Detroit (AL)	Chicago (NL)	4-2	1985	Kansas City (AL)	St. Louis (NL)	4-3
1936	New York (AL)	New York (NL)	4-2	1986	New York (NL)	Boston (AL)	4-3
1937	New York (AL)	New York (NL)	4-1	1987	Minnesota (AL)	St. Louis (NL)	4-3
1938	New York (AL)	Chicago (NL)	4-0	1988	Los Angeles (NL)	Oakland (AL)	4-1
1939	New York (AL)	Cincinnati (NL)	4-0	1989	Oakland (AL)	San Francisco (NL)	4-0
1940	Cincinnati (NL)	Detroit (AL)	4-3	1990	Cincinnati (NL)	Oakland (AL)	4-0
1941	New York (AL)	Brooklyn (NL)	4-1	1991	Minnesota (AL)	Atlanta (NL)	4-3
1942	St. Louis (NL)	New York (AL)	4-1	1992	Toronto (AL)	Atlanta (NL)	4-2
1943	New York (AL)	St. Louis (NL)	4-1	1993	Toronto (AL)	Philadelphia (NL)	4-2
1944	St. Louis (NL)	St. Louis (AL)	4-2	1994	Not held		
1945	Detroit (AL)	Chicago (NL)	4-3	1995	Atlanta (NL)	Cleveland (AL)	4-2
1946	St. Louis (NL)	Boston (AL)	4-3	1996	New York (AL)	Atlanta (NL)	4-2
1947	New York (AL)	Brooklyn (NL)	4-3	1997	Florida (NL)	Cleveland (AL)	4-3
1948	Cleveland (AL)	Boston (NL)	4-2	1998	New York (AL)	San Diego (NL)	4-0
1949	New York (AL)	Brooklyn (NL)	4-1	1999	New York (AL)	Atlanta (NL)	4-0
1950	New York (AL)	Philadelphia (NL)	4-0	2000	New York (AL)	New York (NL)	4-1
1951	New York (AL)	New York (NL)	4-2	2001	Arizona (NL)	New York (AL)	4-3
1952	New York (AL)	Brooklyn (NL)	4-3				

*(AL) American League. †(NL) National League. **Series included a tie game called off because of darkness.

owned by, or have a *working agreement* with, a major league team. Under a working agreement, the major league team helps support the minor league team, usually by paying that team's salaries. In return, the minor league team trains players for the major league team.

The minor league classifications—from the highest to the lowest—are Class AAA, Class AA, and Class A. Most players start their career in a Class A league. As they improve, they move to a higher league, and some eventually reach the major leagues. Most minor league teams play in the United States. A few play in southern Canada. Mexico also has a league. Each year, the major leagues hold a *draft* to select new players. The teams select players primarily from high school and college teams. The new players are normally assigned to a minor league team to gain experience.

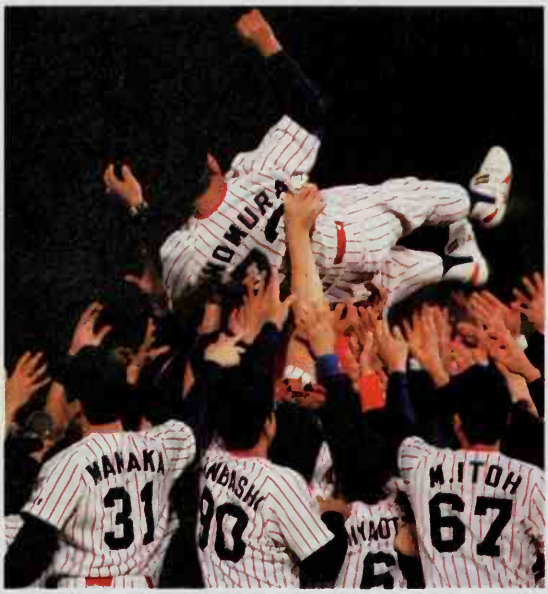
Amateur leagues

A number of national and regional organizations administer amateur baseball programs for young players. They include the American Amateur Baseball Congress, Babe Ruth Baseball, Little League Baseball, and Pony Baseball. Players can join leagues in some organizations when they are 6 years old. The players may advance to other leagues in the program until they are in their late teens. Local organizations, such as park districts, have similar programs for young players. Teen-agers also play amateur baseball in American Legion leagues and Babe Ruth leagues. Most high schools and colleges have baseball teams that are in a league. The National Baseball Congress sponsors amateur leagues for adults.

Most amateur baseball leagues follow the same rules as the major leagues, but some have special rules. For example, the teams of leagues for young players play on fields that are smaller than those of the major leagues. Also, the games of these teams may be scheduled for fewer than nine innings. Some leagues allow players to use aluminum bats to hold down the cost of equipment. Wooden bats sometimes break when a batter hits the ball, but aluminum bats do not. High school leagues allow starting players to leave and return to the game once. This rule enables more players to participate.

Baseball around the world

Baseball has become popular in a number of countries outside the United States and Canada. It is especially strong in Latin America and Japan. Many of the biggest stars in American major league baseball have come from Puerto Rico, Venezuela, and such Caribbean countries as Cuba and the Dominican Republic. Baseball is one of the most popular sports in Mexico, exceeded only by soccer. Many Mexicans play on baseball teams in



AP/Wide World

Baseball in Japan is the country's favorite sport. The champions of two professional leagues play for the national title. The winning team, *shown here,* traditionally tosses its manager in the air.

amateur leagues. Mexico also has professional leagues.

In Japan, baseball has become the national sport. An American teacher at the Kaisei School in Tokyo introduced the game to Japan in 1873. Baseball grew rapidly in popularity among students. Today, thousands of secondary schools and colleges field baseball teams. Professional baseball in Japan began in 1934, when the Tokyo Yomiuri Giants team was organized. In 1935, the Osaka Tigers team was founded. In 1936, seven teams formed the Japan Professional Baseball Federation, which was disbanded during World War II (1939-1945). Since 1950, two professional leagues, each consisting of six teams, have competed. The champions of each league then compete in a seven-game tournament for the national championship.

Baseball has also spread to some European countries. In 1953, European countries formed the European Baseball Federation to organize the European Baseball Championship. Nine countries take part—Belgium, France, Germany, Italy, the Netherlands, Poland, Spain, Sweden, and the United Kingdom.

Baseball is widely played in Australia. Visiting American miners introduced baseball to Australia in 1873. Five states began competing for the Claxton Shield in 1934. The game increased in popularity after it changed from a winter sport to a summer sport in 1965. Australia joined the Baseball Federation of Asia in 1970.

History

Baseball began in the United States in the mid-1800's. Historical evidence indicates that Americans developed the game from an old English sport called *rounders.* In spite of this evidence, many people believe that Abner Doubleday of the United States invented baseball.

Early development

Rounders. People in England played rounders as early as the 1600's. Rounders, like baseball, involved hitting a ball with a bat and advancing around bases. Although rounders resembled baseball, there were many differences between the two games. Perhaps the main difference was the way in which fielders put out base runners. Fielders threw the ball at runners. If the ball hit a runner who was off base, the runner was out. This practice was called *soaking* or *plugging* runners.

From rounders to baseball. American colonists in New England played rounders as early as the 1700's. They called the game by several names, including *town ball,* the *Massachusetts game,* and—sometimes—*base ball.* Rules for the game appeared in books from time to time. Even so, people generally played the game according to their local customs. The number of players on a side, the number of bases and distance between them, and other rules varied from place to place.

Americans gradually changed the game into baseball. The earliest known published reference to organized baseball appeared in the July 13, 1825, edition of the *Delhi* (New York) *Gazette.*

One of the key points in the development of baseball took place when players replaced the practice of soaking runners with the present practice of tagging them. Historians believe players in New York City probably made the change in the 1830's or 1840's.

The Abner Doubleday Theory. In spite of evidence showing that baseball developed from rounders, many people believe that Abner Doubleday invented the game in Cooperstown, New York, in 1839. Doubleday later became a general in the U.S. Army. He died in 1893.

The Doubleday Theory arose from a dispute over the origin of baseball in the early 1900's. A commission was appointed to settle the question of the game's origin. Many people told the commission that baseball developed from rounders. But the commission's report, published in 1908, credited Doubleday with inventing the game. It based its conclusion on a letter from Abner Graves, who had been a boyhood friend of Doubleday's. Graves said he had been present when Doubleday invented baseball in Cooperstown in 1839.

Historians now believe that Doubleday had little, if anything, to do with baseball. They also point out that the game described by Graves included the practice of soaking runners. Thus, it was not essentially different from rounders.

Alexander Cartwright, a New York City sportsman, is called the *father of organized baseball.* In 1845, he started a club whose only purpose was playing baseball. Called the *Knickerbocker Base Ball Club of New York,* it was the first organization of its kind. Cartwright wrote a set of baseball rules when he organized the club. These rules, together with rules added in 1848 and 1854, did much to make baseball the game it is today.

The 1845 rules set the distance between the bases at 90 feet (27.4 meters), and provided for nine players on a side. They contain the first known mention of the need to tag runners rather than soaking them. The 1848 addition included the present-day rule of tagging first base to put a batter out on a ground ball. The force out rule was added in 1854.

The American National Game of Baseball (1846), a color lithograph by Currier & Ives; (WORLD BOOK photo of a lithographic reproduction published by Shorewood Publishers, Inc.)

An early baseball game between two organized teams took place on the Elysian Fields in Hoboken, New Jersey, on June 19, 1846. It matched the Knickerbocker Base Ball Club of New York and the New York Nine. The New York Nine won the game, 23 to 1.

Rule changes. Although Cartwright's rules and today's rules are alike in many ways, there are also many differences between the two. Following are some of the original rules and the dates when they were changed.

Length of game. Cartwright provided that the first team to have 21 or more runs at the end of an inning won the game. The present rule in which the team with the most runs after nine innings wins was adopted in 1857.

Pitching. At first, the pitcher stood 45 feet (13.7 meters) from home plate and had to throw the ball underhanded. The pitching distance was increased to 50 feet (15.2 meters) in 1881 and to the present 60 feet 6 inches (18.4 meters) in 1893. The rule that allows the pitcher to throw overhanded was adopted in 1884.

Fly outs. Originally, a batter was out if a fielder caught the ball either on the fly or on the first bounce. An 1864 rule change provided that fair balls caught on the bounce were not outs. An 1883 rule change provided that foul balls caught on the bounce were not outs.

Strikes and balls. In early baseball, batters only made strikes by swinging and missing. Called strikes became part of the game in 1868. The National League adopted the foul strike rule in 1901, and the American League in 1903. There was no such thing as a walk in early baseball. An 1879 rule change provided that a batter walked after nine balls. The present four-ball rule was introduced in 1889 after several changes.

The spread of the game

Groups throughout the eastern United States formed baseball clubs shortly after the Knickerbocker Club began. The Civil War (1861-1865) helped spread baseball to all parts of the country. Union soldiers who knew about the game often played it for recreation. Other Union troops and Confederate prisoners watched them. In this way, people from many parts of the nation learned baseball. They taught it to others when they returned home after the war. Soon, people in cities and towns and on farms in all parts of the country began playing baseball.

Professional baseball. All early baseball players were amateurs. But in 1869, the Cincinnati Red Stockings decided to pay all its players and became the first professional baseball team. Many other teams then turned professional. In 1876, eight professional teams formed the National League, the first major league. Eight teams formed the American League in 1900. The American League became the second major league in 1901.

At first, the cities represented by major league teams changed often. By 1900, the National League had teams in Boston, Brooklyn, Chicago, Cincinnati, New York City, Philadelphia, Pittsburgh, and St. Louis. By 1903, the American League teams represented Boston, Chicago, Cleveland, Detroit, New York City, Philadelphia, St. Louis, and Washington, D.C. The same 16 teams were to make up the major leagues and play in the same cities for 50 years.

Early strategy and stars. Early major league baseball is sometimes called the *dead ball era.* Baseballs used from the start of the game until about 1920 were "dead"; that is, less lively than those used today. Most batters were place hitters rather than long ball hitters. Wee Willie Keeler, a leading batter of baseball's early days, stated the batting philosophy of the era. His famous motto was: "I hit 'em where they ain't."

Bunting and base stealing were more common in the early days than they are now. But since the early 1960's, there has been an increase in base stealing. King Kelly probably was the most popular player of the late 1800's. His fame came from his ability to run the bases. Fans urged him on with the chant, "Slide, Kelly, Slide."

Other stars of the 1800's included Cap Anson and Charlie (Old Hoss) Radbourn. Anson became the first player to make more than 3,000 base hits during a career. Radbourn pitched 73 complete games in 1884 and won 60 of them.

National Baseball Hall of Fame, Cooperstown, New York

Members are elected to the Hall of Fame (1) each year by the 10-year members of the Baseball Writers Association of America or (2) every other year by a committee that includes all living members of the Hall of Fame plus writers and broadcasters who have won awards linked to the Hall. In most cases, players who are candidates for the Hall of Fame must be retired for at least 5 years and have played at least 10 years in the major leagues.

Name	Position	Years at position(s) listed
Aaron, Henry	Outfielder	1954-1976
Alexander, Grover	Pitcher	1911-1930
Alston, Walter	Manager	1954-1976
Anderson, Sparky	Manager	1970-1995
Anson, Cap	First baseman	1876-1897
Aparicio, Luis	Shortstop	1956-1973
Appling, Luke	Shortstop	1930-1950
Ashburn, Richie	Outfielder	1948-1962
Averill, Earl	Outfielder	1929-1941
Baker, Home Run	Third baseman	1908-1922
Bancroft, Dave	Shortstop; manager	1915-1930; 1924-1927
Banks, Ernie	Shortstop, first baseman	1953-1971
Barlick, Al	Umpire	1940-1943, 1946-1955, 1958-1970
Barrow, Edward G.	Executive	1921-1947
Beckley, Jake	First baseman	1888-1907
*Bell, Cool Papa	Outfielder	1922-1950
Bench, Johnny	Catcher	1967-1983
Bender, Chief	Pitcher	1903-1917, 1925
Berra, Yogi	Catcher	1946-1965
Bottomley, Jim	First baseman	1922-1937
Boudreau, Lou	Shortstop; manager	1938-1952; 1943-1950, 1952-1957, 1960
Bresnahan, Roger	Catcher	1897-1915
Brett, George	Third baseman, first baseman	1973-1993
Brock, Lou	Outfielder	1961-1979
Brouthers, Dan	First baseman	1879-1896, 1904
Brown, Mordecai	Pitcher	1903-1916
Bulkeley, Morgan G.	First President, National League	1876
Bunning, Jim	Pitcher	1955-1971
Burkett, Jesse	Outfielder	1890-1905
Campanella, Roy	Catcher	1948-1957
Carew, Rod	First baseman, second baseman	1967-1985
Carey, Max	Outfielder	1910-1929
Carlton, Steve	Pitcher	1965-1988
Cartwright, Alexander	"Father of Organized Baseball"	1845
Cepeda, Orlando	First baseman, outfielder	1958-1974
Chadwick, Henry	Author of first rule book	1860-1908
Chance, Frank	First baseman; manager	1898-1914; 1905-1914, 1923
Chandler, Happy	Commissioner	1945-1951
*Charleston, Oscar	First baseman, outfielder	1915-1954
Chesbro, Jack	Pitcher	1899-1909
Chylak, Nestor	Umpire	1954-1978
Clarke, Fred	Outfielder; manager	1894-1915; 1897-1899, 1900-1915
Clarkson, John	Pitcher	1882-1894
Clemente, Roberto	Outfielder	1955-1972
Cobb, Ty	Outfielder	1905-1928
Cochrane, Mickey	Catcher	1925-1937
Collins, Eddie	Second baseman	1906-1930
Collins, Jimmy	Third baseman	1895-1908
Combs, Earle	Outfielder	1924-1935
Comiskey, Charles A.	First baseman; owner	1882-1894; 1900-1931
Conlan, Jocko	Umpire	1941-1965
Connolly, Tom	Umpire	1898-1931
Connor, Roger	First baseman	1880-1897
Coveleski, Stan	Pitcher	1912, 1916-1928
Crawford, Sam	Outfielder	1899-1917
Cronin, Joe	Shortstop; manager	1926-1945; 1933-1947
Cummings, Candy	Pitcher	1876-1877
Cuyler, Kiki	Outfielder	1921-1937
*Dandridge, Ray	Third baseman	1933-1949
Davis, George	Shortstop, third baseman, outfielder	1890-1909
*Day, Leon	Pitcher	1934-1949
Dean, Dizzy	Pitcher	1930-1941, 1947
Delahanty, Ed	Outfielder	1888-1903
Dickey, Bill	Catcher	1928-1943, 1946
*Dihigo, Martin	Outfielder; pitcher	1923-1936; 1945
DiMaggio, Joe	Outfielder	1936-1942, 1946-1951
Doby, Larry	Outfielder	1947-1959
Doerr, Bobby	Second baseman	1937-1944, 1946-1951
Drysdale, Don	Pitcher	1956-1968
Duffy, Hugh	Outfielder	1888-1906
Durocher, Leo	Shortstop, second baseman	1925, 1928-1941, 1943, 1945
	Manager	1939-1946, 1948-1955, 1966-1973
Evans, Billy	Umpire	1906-1927
Evers, Johnny	Second baseman	1902-1917, 1922, 1929
Ewing, Buck	Catcher	1880-1897
Faber, Red	Pitcher	1914-1933
Feller, Bob	Pitcher	1936-1941, 1945-1956
Ferrell, Rick	Catcher	1929-1945, 1947
Fingers, Rollie	Pitcher	1968-1982, 1984-1985
Fisk, Carlton	Catcher	1969, 1971-1992
Flick, Elmer	Outfielder	1898-1910
Ford, Whitey	Pitcher	1950, 1953-1967
Foster, Bill	Pitcher	1923-1937
Foster, Rube	Founder, National Negro League	1902-1926
Fox, Nelson	Second baseman	1947-1965
Foxx, Jimmie	First baseman	1925-1942, 1944-1945
Frick, Ford	Commissioner	1951-1965
Frisch, Frankie	Second baseman; manager	1919-1937; 1933-1938, 1940-1946, 1949-1951
Galvin, Pud	Pitcher	1879-1892
Gehrig, Lou	First baseman	1923-1939
Gehringer, Charlie	Second baseman	1924-1942
Gibson, Bob	Pitcher	1959-1975
*Gibson, Josh	Catcher	1930-1946
Giles, Warren	President, National League	1952-1970
Gomez, Lefty	Pitcher	1930-1943
Goslin, Goose	Outfielder	1921-1938
Greenberg, Hank	First baseman	1930, 1933-1941, 1945-1947
Griffith, Clark	Pitcher; manager; owner	1891, 1893-1907, 1909-1910, 1912-1914; 1901-1920; 1912-1955
Grimes, Burleigh	Pitcher	1916-1934
Grove, Lefty	Pitcher	1925-1941
Hafey, Chick	Outfielder	1924-1935, 1937
Haines, Jesse	Pitcher	1918, 1920-1937
Hamilton, Billy	Outfielder	1888-1901
Hanlon, Ned	Outfielder; manager	1880-1892; 1889-1907
Harridge, Will	President, American League	1931-1958
Harris, Bucky	Second baseman; manager	1919-1929, 1931; 1924-1943, 1947-1948, 1950-1956
Hartnett, Gabby	Catcher	1922-1941
Heilmann, Harry	Outfielder	1914, 1916-1930, 1932
Herman, Billy	Second baseman	1931-1943, 1946-1947
Hooper, Harry	Outfielder	1909-1925
Hornsby, Rogers	Second baseman	1915-1937
Hoyt, Waite	Pitcher	1918-1938
Hubbard, Cal	Umpire	1937-1951
Hubbell, Carl	Pitcher	1928-1943
Huggins, Miller	Second baseman; manager	1904-1916; 1913-1929
Hulbert, William	Founder, National League	1876
Hunter, Catfish	Pitcher	1965-1979
†Irvin, Monte	Outfielder	mid 1930's-1942, 1945-1949; 1949-1956
Jackson, Reggie	Outfielder	1967-1987
Jackson, Travis	Shortstop	1922-1936
Jenkins, Ferguson	Pitcher	1965-1983
Jennings, Hugh	Shortstop	1891-1903, 1907, 1909, 1912, 1918
Johnson, Ban	Organizer	1901-1927
*Johnson, Judy	Third baseman	1921-1938
Johnson, Walter	Pitcher	1907-1927
Joss, Addie	Pitcher	1902-1910
Kaline, Al	Outfielder	1953-1974
Keefe, Tim	Pitcher	1880-1893
Keeler, Wee Willie	Outfielder	1892-1910
Kell, George	Third baseman	1943-1957
Kelley, Joe	Outfielder	1891-1906, 1908
Kelly, George	First baseman	1915-1917, 1919-1930, 1932
Kelly, King	Catcher, outfielder	1878-1893
Killebrew, Harmon	Infielder, outfielder	1954-1975
Kiner, Ralph	Outfielder	1946-1955

*Entire career spent in Negro leagues. †Years in Negro leagues given before semicolon, followed by years in major leagues.

Name	Position	Years at position(s) listed
Klein, Chuck	Outfielder	1928-1944
Klem, Bill	Umpire	1905-1940
Koufax, Sandy	Pitcher	1955-1966
Lajoie, Napoleon	Second baseman	1896-1916
Landis, Kenesaw Mountain	First commissioner	1920-1944
Lasorda, Tom	Manager	1976-1996
Lazzeri, Tony	Second baseman	1928-1939
Lemon, Bob	Pitcher	1946-1958
*Leonard, Buck	First baseman	1933-1950
Lindstrom, Fred	Third baseman	1924-1936
*Lloyd, Pop	Shortstop	1905-1931
Lombardi, Ernie	Catcher	1931-1947
Lopez, Al	Catcher; manager	1928, 1930-1947; 1951-1965, 1968-1969
Lyons, Ted	Pitcher	1923-1942, 1946
Mack, Connie	Catcher; owner	1886-1896; 1894-1896, 1901-1950
MacPhail, Larry	Executive	1934-1936, 1938-1942, 1946-1947
MacPhail, Lee	Executive	1948-1983
Mantle, Mickey	Outfielder	1951-1968
Manush, Heinie	Outfielder	1923-1939
Maranville, Rabbit	Shortstop	1912-1935
Marichal, Juan	Pitcher	1960-1975
Marquard, Rube	Pitcher	1908-1925
Mathews, Eddie	Third baseman	1952-1968
Mathewson, Christy	Pitcher	1900-1916
Mays, Willie	Outfielder	1951-1952, 1954-1972
Mazeroski, Bill	Second baseman	1956-1972
McCarthy, Joe	Manager	1926-1946, 1948-1950
McCarthy, Tommy	Outfielder	1884-1896
McCovey, Willie	First baseman	1959-1980
McGinnity, Joe	Pitcher	1899-1908
McGowen, Bill	Umpire	1925-1954
McGraw, John	Third baseman; manager	1891-1906; 1899, 1901-1932
McKechnie, Bill	Manager	1922-1926, 1928-1946
McPhee, Bid	Second baseman	1882-1899
Medwick, Joe	Outfielder	1932-1948
Mize, Johnny	First baseman	1936-1942, 1946-1953
Morgan, Joe	Second baseman	1963-1984
Musial, Stan	Outfielder; first baseman	1941-1944; 1946-1963
Newhouser, Hal	Pitcher	1939-1955
Nichols, Kid	Pitcher	1890-1906
Niekro, Phil	Pitcher	1965-1987
O'Rourke, Jim	Outfielder; catcher	1876-1893; 1904
Ott, Mel	Outfielder	1926-1947
†Paige, Satchel	Pitcher	1926-1947; 1948-1953, 1965
Palmer, Jim	Pitcher	1965-1984
Pennock, Herb	Pitcher	1912-1917, 1919-1934
Perez, Tony	First baseman, third baseman	1964-1986
Perry, Gaylord	Pitcher	1962-1983
Plank, Ed	Pitcher	1901-1917
Puckett, Kirby	Outfielder	1984-1995
Radbourn, Charlie	Pitcher	1880-1891
Reese, Pee Wee	Shortstop	1940-1942, 1946-1958
Rice, Sam	Outfielder	1915-1934
Rickey, Branch	Executive	1919-1955
Rixey, Eppa	Pitcher	1912-1917, 1919-1933
Rizzuto, Phil	Shortstop	1941-1942, 1946-1956
Roberts, Robin	Pitcher	1948-1966
Robinson, Brooks	Third baseman	1959-1977
Robinson, Frank	Outfielder	1956-1976
Robinson, Jackie	Second baseman	1947-1956
Robinson, Wilbert	Catcher; manager	1886-1902; 1902, 1914-1931
Rogan, Joe	Pitcher, infielder, outfielder	1920-1931, 1936-1938
Roush, Edd	Outfielder	1913-1929, 1931
Ruffing, Red	Pitcher	1924-1942, 1945-1947
Rusie, Amos	Pitcher	1889-1898, 1901
Ruth, Babe	Outfielder, pitcher	1914-1935
Ryan, Nolan	Pitcher	1966, 1968-1993
Schalk, Ray	Catcher	1912-1929
Schmidt, Mike	Third baseman	1972-1989
Schoendienst, Red	Second baseman; manager	1945-1963; 1965-1976, 1980
Seaver, Tom	Pitcher	1967-1986
Selee, Frank	Manager	1890-1905
Sewell, Joe	Shortstop, third baseman	1920-1933
Simmons, Al	Outfielder	1924-1941, 1943-1944
Sisler, George	First baseman, pitcher	1915-1922, 1924-1930
Slaughter, Enos	Outfielder	1938-1942, 1946-1959
*Smith, Hilton	Pitcher	1932-1948
Smith, Ozzie	Shortstop	1978-1996
Snider, Duke	Outfielder	1947-1964
Spahn, Warren	Pitcher	1942, 1946-1965
Spalding, Albert G.	Pitcher	1876-1877
Speaker, Tris	Outfielder	1907-1928
Stargell, Willie	Outfielder, first baseman	1962-1982
*Stearnes, Turkey	Outfielder	1921-1942
Stengel, Casey	Outfielder; manager	1912-1925; 1934-1936, 1938, 1943, 1949-1960, 1962-1965
Sutton, Don	Pitcher	1966-1988
Terry, Bill	First baseman	1923-1936
Thompson, Sam	Outfielder	1885-1898, 1906
Tinker, Joe	Shortstop	1902-1916
Traynor, Pie	Third baseman	1920-1935, 1937
Vance, Dazzy	Pitcher	1915, 1918, 1922-1935
Vaughan, Arky	Shortstop	1932-1943, 1947-1948
Veeck, Bill	Owner	1946-1954, 1959-1960, 1975-1980
Waddell, Rube	Pitcher	1897, 1899-1910
Wagner, Honus	Shortstop	1897-1917
Wallace, Bobby	Shortstop	1894-1918
Walsh, Ed	Pitcher	1904-1917
Waner, Lloyd	Outfielder	1927-1942, 1944-1945
Waner, Paul	Outfielder	1926-1945
Ward, John M.	Infielder, outfielder, pitcher	1878-1894
Weaver, Earl	Manager	1968-1982, 1985-1986
Weiss, George	Executive	1932-1960
Welch, Mickey	Pitcher	1880-1892
*Wells, Willie	Shortstop	1924-1950
Wheat, Zack	Outfielder	1909-1927
Wilhelm, Hoyt	Pitcher	1952-1972
Williams, Billy	Outfielder	1959-1976
*Williams, Smokey Joe	Pitcher	1905-1932
Williams, Ted	Outfielder	1939-1942; 1946-1960
Willis, Vic	Pitcher	1898-1910
Wilson, Hack	Outfielder	1923-1934
Winfield, Dave	Outfielder	1973-1995
Wright, George	Shortstop	1876-1882
Wright, Harry	Manager	1871-1893
Wynn, Early	Pitcher	1939, 1941-1944, 1946-1963
Yastrzemski, Carl	Outfielder, first baseman	1961-1983
Yawkey, Tom	Owner	1933-1976
Young, Cy	Pitcher	1890-1911
Youngs, Ross	Outfielder	1917-1926
Yount, Robin	Shortstop, outfielder	1974-1993

*Entire career spent in Negro leagues. †Years in Negro leagues given before semicolon, followed by years in major leagues.

The 1900's

Interest in baseball soared after 1900. The game soon played such an important part in American life that it became known as the *national pastime*. Many boys spent almost all their leisure time during warm weather playing baseball. People in all walks of life eagerly followed the major league pennant races and the World Series. Star players became local, or even national, heroes. Many people could name every major league player, and knew the batting averages and other accomplishments of players. Jacques Barzun, a famous philosopher and educator, perhaps best summed up the importance of baseball in American life. Barzun wrote: "Whoever wants to know the heart and mind of America had better learn baseball."

The early 1900's. The year 1900 marks the beginning of the *modern era* of major league baseball. By that time, the two major leagues had been formed, and most baseball rules were the same as today. Records established by players and teams are divided into two categories: *modern* (since 1900) and *premodern* (before 1900). Career records made by players who played during both periods are counted as modern records. For

example, Cy Young holds the modern record for most games won by a pitcher (511). But Young won about half of these games before, and half after, 1900.

Ty Cobb, a Detroit Tiger outfielder of the early 1900's, became one of the greatest and most exciting players of all time. He ranks as the all-time leading hitter in the major leagues with a .367 career batting average. Honus Wagner of the Pittsburgh Pirates was another great star of the era. A bowlegged shortstop, Wagner led the National League in batting eight times and ranked among the best fielders and base runners. Outstanding early pitchers included Christy Mathewson of the New York Giants, Grover Cleveland Alexander of the Philadelphia Phillies and other teams, and Walter Johnson of the Washington Senators. Mathewson and Alexander hold the record for most games won by a pitcher in the National League (373). Johnson's blazing fast ball helped him become baseball's "strikeout king." He struck out more batters than any other pitcher in American League history (3,508). He won 416 games, more than any pitcher except Cy Young.

The Black Sox Scandal. In 1919, the Cincinnati Reds defeated the Chicago White Sox in the World Series. The next year, eight White Sox players were accused of *throwing* (trying to lose) the World Series in return for money from gamblers. Baseball Commissioner Kenesaw Mountain Landis banned the eight players from baseball. This scandal, called the *Black Sox Scandal,* shocked fans and hurt the game's reputation. Landis had been appointed commissioner in 1920 especially to investigate the scandal. A federal judge with a reputation for honesty, he helped restore public confidence in baseball.

The Babe Ruth Era. Also in 1920, Babe Ruth joined the New York Yankees. Around that time, teams began using livelier baseballs. Ruth began hitting more and longer home runs than anyone thought possible. He hit more than 50 homers in four different seasons, including a record 60 home runs in 1927. Before Ruth, no player had hit more than 24 in a season. Ruth had hit 714 home runs when he retired in 1935.

Ruth's fame became so great that the 1920's in baseball is often called the *Babe Ruth Era.* Wherever the Yankees played, fans flocked to see Ruth. Large numbers of people who knew nothing about baseball began following Ruth's career and the game. In addition, Ruth's success helped change baseball strategies. More batters became full swingers rather than place hitters, and home runs became a leading part of the game.

Baseball's many other stars of the Babe Ruth Era included first baseman Lou Gehrig. Gehrig became the first modern player to hit four home runs in a game. He also played in 2,130 consecutive games, a major league record until Cal Ripken, Jr., broke it in 1995. Rogers Hornsby reached his peak during the era. In 1924, he hit .424 for the St. Louis Cardinals, a modern record.

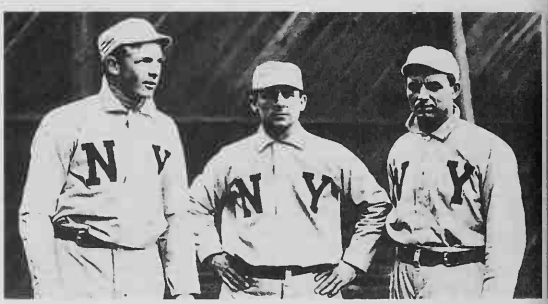
Many radio stations began broadcasting baseball games during the 1920's. As a result, play-by-play accounts of baseball games reached millions of people.

Depression and war. Major league baseball, like other businesses, faced economic hardship during the Great Depression of the 1930's. Money received from radio stations in return for the right to broadcast games helped teams financially. Also, some team owners installed lights in ballparks so that teams could play at night and attract fans who worked during the day. The first night game took place in Crosley Field, Cincinnati, between the Cincinnati Reds and Philadelphia Phillies on May 24, 1935. The first All-Star Game was played in Comiskey Park in Chicago on July 6, 1933. The Baseball Hall of Fame opened in Cooperstown in 1939.

The United States entered World War II in 1941. Many major league players served in the armed forces. From 1942 through 1945, teams used many players who were too old, too young, or physically unable to serve in the armed forces. The war ended in 1945, and most of the players returned to baseball for the 1946 season.

During the war, the All-American Girls Professional Baseball League was formed, with teams in several small Midwestern cities. Play began in 1943 and ended after the 1954 season.

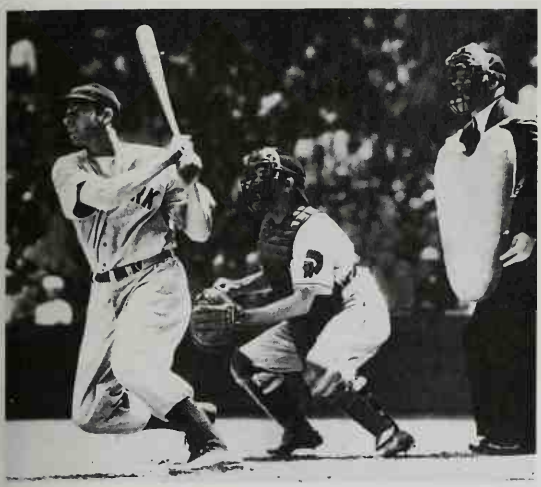
The many stars who played both before and after the war included Joe DiMaggio, Ted Williams, Stan Musial, and Bob Feller. DiMaggio, a Yankee outfielder, became one of the game's greatest all-around players. He set a record when he made one or more base hits in 56 consecutive games in 1941. Williams, a Boston Red Sox out-



Brown Bros.

Early stars of baseball included, *above, left to right,* Christy Mathewson, a top pitcher in the early 1900's; John McGraw, his manager; and Joe McGinnity, also a pitcher in the early 1900's. Babe Ruth, *below,* was the game's first great home run hitter.

UPI/Bettmann



United Press Int.

Joe DiMaggio helped lead the New York Yankees to nine world championships during his 13-year career. In 1941, he made one or more base hits in 56 consecutive games.

fielder, ranks among baseball's all-time great hitters. He had a lifetime batting average of .344. In 1941, Williams batted .406, marking the last time anyone hit over .400. Musial starred as a first baseman and outfielder for the Cardinals. He won seven National League batting titles. Feller, a pitcher for Cleveland, won fame for his blazing fast ball and many strikeouts.

Postwar baseball. Attendance at baseball games soared after World War II. In the late 1940's and early 1950's, many teams began televising some games.

Until the mid-1940's, black players were not allowed to play in the major leagues. Instead, they played in leagues made up entirely of blacks. These *Negro leagues* received little publicity. But they had many outstanding players, including Cool Papa Bell, an outfielder; Josh Gibson, a catcher; and Satchel Paige, a pitcher.

Jackie Robinson became the first black player in modern major league baseball when he joined the Brooklyn Dodgers in 1947. Many other black players entered the major leagues after Robinson.

The Yankees had become baseball's strongest team during the Babe Ruth Era. From then until the 1960's, they dominated the game more than any other team before or since. From 1949 through 1953, they established a record by winning five straight pennants and World Series. Casey Stengel was their manager.

Franchise shifts and expansion brought about important changes in the major leagues. In 1953, the Boston Braves moved to Milwaukee, marking the first time a National League *franchise* (team) had moved since 1900. In 1954, the St. Louis Browns moved to Baltimore and changed their name to the Orioles, in the first American League shift since 1903. Several other teams later moved to other cities. Also, during the 1960's, the American and National leagues each added four new teams. In 1969, each league split into two 6-team divisions. In 1977, the American League expanded to 14 teams.

Recent developments. In 1961, the American League increased the number of games played by each team yearly from 154 to 162. The National League went to 162 games in 1962. In 1998, Mark McGwire of the St. Louis Cardinals and Sammy Sosa of the Chicago Cubs dueled in the greatest home run competition in major league history. McGwire broke Roger Maris's single season record of 61 homers and ended the season with a

Wide World

Ted Williams ranks among the top 10 modern players in both lifetime batting average and home runs. In 1941, he batted .406, marking the last time any player hit over .400 in a season.

Modern major league records

Record	Total	Player	Year(s)
Home runs:			
Season	73	Barry Bonds	2001
Career	755	Henry Aaron	1954-1976
Batting average:			
Season	.424	Rogers Hornsby	1924
Career	.367	Ty Cobb	1905-1928
Runs batted in:			
Season	190	Hack Wilson	1930
Career	2,297	Henry Aaron	1954-1976
Runs scored:			
Season	177	Babe Ruth	1921
Career	2,288	Rickey Henderson	1979- *
Base hits:			
Season	257	George Sisler	1920
Career	4,256	Pete Rose	1963-1986
Consecutive game hitting streak:			
	56	Joe DiMaggio	1941
Stolen bases:			
Season	130	Rickey Henderson	1982
Career	1,403	Rickey Henderson	1979- *
Wins (Pitching):			
Season	41	Jack Chesbro	1904
Career	511	Cy Young	1890-1911
Strikeouts (Pitching):			
Season	383	Nolan Ryan	1973
Career	5,714	Nolan Ryan	1966-1993
Shutouts:			
Season	16	Grover Alexander	1916
Career	113	Walter Johnson	1907-1927
Consecutive	6	Don Drysdale	1968
Consecutive scoreless innings:			
	59	Orel Hershiser	1988
Consecutive games played:			
	2,632	Cal Ripken, Jr.	1982-1998

*As of the end of the 2002 regular season.

United Press Int.

Jackie Robinson became the first black player in modern major league baseball. He joined the Brooklyn Dodgers in 1947. He gained fame for his hitting and his daring base running.

Culver

Satchel Paige was a star pitcher for Negro teams for about 30 years before major league baseball became integrated. Paige entered the American League in 1948 at the age of 43.

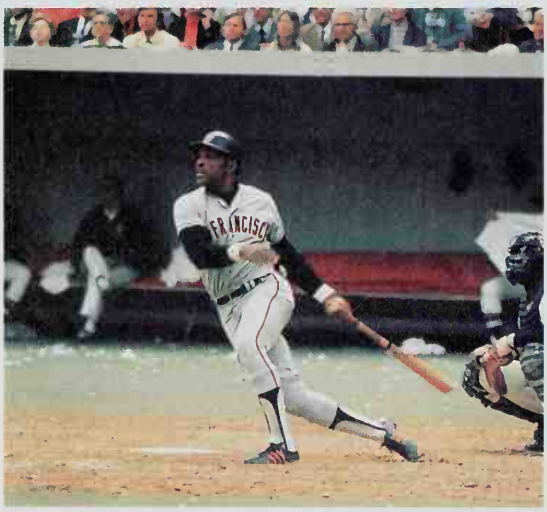
record 70 home runs. Sosa finished with 66. Barry Bonds broke McGwire's record by hitting 73 home runs in 2001.

Lou Brock, a Cardinal outfielder, set a record for career stolen bases, stealing 938 bases by the time he retired after the 1979 season. Brock broke Ty Cobb's record of 892 stolen bases. In 1991, Rickey Henderson, an outfielder for the Oakland Athletics, broke Brock's career record of 938 stolen bases.

Sandy Koufax, a Dodger star of the 1960's, became the first player to pitch four no-hit games in the major leagues. Nolan Ryan of the Houston Astros broke this record in 1981, when he pitched his fifth career no-hitter. Ryan pitched a sixth no-hitter in 1990 and a seventh in 1991. In 1973, Ryan struck out 383 batters, a major league record for one season.

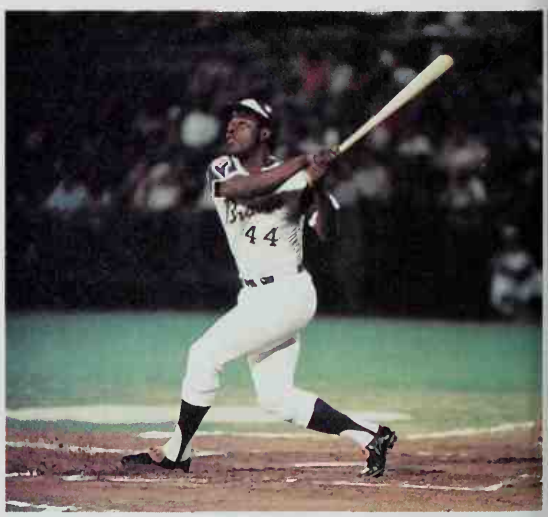
Baseball's many other great stars of recent years include Willie Mays, Frank Robinson, and Henry Aaron, all outfielders. Mays played for the New York (later San Francisco) Giants in the 1950's, 1960's, and early 1970's. He excelled as a hitter, fielder, and base runner. Robinson starred as a hitter in both the American and National leagues. He also became the first black manager in major league history in 1974, when he was named manager of the Cleveland Indians.

Aaron joined the Milwaukee (now Atlanta) Braves in 1954. Several players received more publicity than Aaron. But year after year, Aaron ranked among the game's leading hitters. He established many batting records. Finally, he broke what was probably baseball's most glamorous record—Babe Ruth's career home run total. On April 8, 1974, Aaron hit his 715th career home run in Atlanta Stadium. By the time he retired after the



Focus on Sports

Willie Mays was one of the most exciting baseball players of all time. Throughout his long career, Mays thrilled fans with his sensational batting, fielding, and base running.

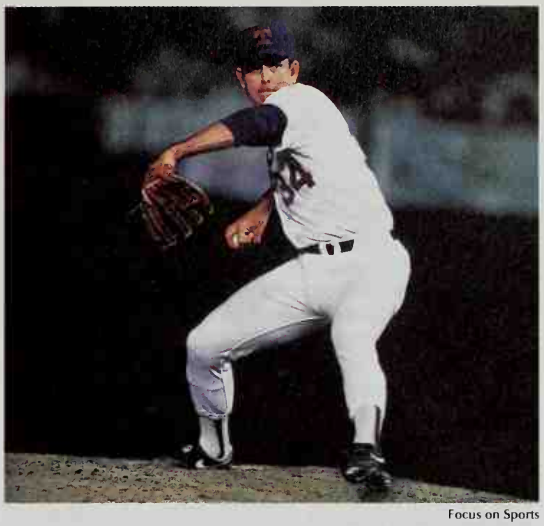


Focus on Sports

Henry Aaron hit more home runs than any other player. His 715th homer, *above,* hit in 1974, broke Babe Ruth's record. He also holds the major league record for runs batted in with 2,297.

Focus on Sports

Pete Rose broke Ty Cobb's record of major league career hits in 1985 with his 4,192nd base hit, *shown here.* He also tied a record set in 1897 by hitting safely in 44 consecutive games.



Focus on Sports

Nolan Ryan holds the major league records for striking out the most batters in a season and over a career. Ryan also became the first major league pitcher to pitch seven no-hit games.

1976 season, Aaron had hit 755 home runs.

On Sept. 11, 1985, player-manager Pete Rose of the Cincinnati Reds broke Ty Cobb's major league record of 4,191 base hits during a career. By the time he retired as a player after the 1986 season, Rose had 4,256 base hits. He continued as manager of the Reds. In 1989, Baseball Commissioner A. Bartlett Giamatti banned Rose from baseball for life on charges that Rose had violated baseball rules by betting on baseball games. Rose denied the charges but did not challenge Giamatti's ruling.

The two major leagues were each reorganized into three divisions—East, Central, and West—beginning with the 1994 season. The play-offs were expanded to include the division winners plus the second place team with the best record in each league.

Conflicts between the union of major league players and the owners of the teams frequently disrupted major league play during the late 1900's. There were eight strikes or lockouts from 1972 to 1994. The most serious work stoppage occurred in 1994. A strike began August 12 over financial issues and led to cancellation of the play-offs and the World Series. It was only the second time that the World Series was not played. The first time occurred in 1904. The players ended their strike on March 31, 1995.

In 1996, the owners and the players' union signed an agreement that guaranteed labor peace for five years. The agreement provided for regular season games between American League and National League teams beginning in 1997. Donald Honig

Franchise shifts and expansion

1953 The Boston Braves moved to Milwaukee.
1954 The St. Louis Browns moved to Baltimore and became the Baltimore Orioles.
1955 The Philadelphia Athletics moved to Kansas City, Missouri.
1958 The Brooklyn Dodgers moved to Los Angeles. The New York Giants moved to San Francisco.
1961 The Washington Senators moved to Minneapolis-St. Paul and became the Minnesota Twins. The American League expanded to 10 teams, adding the Los Angeles Angels and a new Washington Senators team.
1962 The National League expanded to 10 teams, adding the Houston Astros and the New York Mets. (The Astros were nicknamed the Colt .45's until 1965.)
1966 The Los Angeles Angels moved to Anaheim and became the California (now Anaheim) Angels. The Milwaukee Braves moved to Atlanta.
1968 The Kansas City Athletics moved to Oakland.
1969 Both major leagues expanded to 12 teams. The American League added the Kansas City Royals and Seattle Pilots. The National League added the Montreal Expos and San Diego Padres. Both leagues split into two divisions.
1970 The Seattle Pilots moved to Milwaukee and became the Milwaukee Brewers.
1972 The Washington Senators expansion team moved to Dallas-Fort Worth and became the Texas Rangers.
1977 The American League expanded to 14 teams, adding the Toronto Blue Jays and Seattle Mariners.
1991 The National League awarded expansion franchises to Denver (as the Colorado Rockies) and Miami (as the Florida Marlins). The teams began play in 1993.
1995 The major leagues awarded expansion franchises to the Arizona Diamondbacks and the Tampa Bay Devil Rays. Arizona began play in the National League and Tampa Bay in the American League in 1998.

Study aids

Related articles in *World Book* include:

Aaron, Henry
Alexander, Grover C.
Bonds, Barry
Clemens, Roger
Clemente, Roberto
Cobb, Ty
Cooperstown
Dean, Dizzy
DiMaggio, Joe
Doubleday, Abner
Feller, Bob
Foxx, Jimmie
Gehrig, Lou
Gibson, Josh
Griffey, Ken, Jr.
Henderson, Rickey
Hornsby, Rogers
Jackson, Shoeless Joe
Johnson, Walter
Koufax, Sandy
Landis, Kenesaw Mountain
Little League Baseball
Mack, Connie
Maddux, Greg
Mantle, Mickey
Maris, Roger
Mathewson, Christy
Mays, Willie
McGwire, Mark
Musial, Stan
Paige, Satchel

Ripken, Cal, Jr.
Robinson, Frank
Robinson, Jackie
Rose, Pete
Ruth, Babe
Ryan, Nolan
Sanders, Deion
Softball
Sosa, Sammy
Spahn, Warren
Speaker, Tris
Stengel, Casey
Torre, Joe
Wagner, Honus
White, Bill
Williams, Ted
Young, Cy

Outline

I. How the game is played
- A. Players and equipment
- B. The field
- C. Baseball skills
- D. The game

II. Baseball leagues
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Questions

What is a force play?
How are players chosen for the All-Star Game?
Who was Alexander Cartwright?
When does a base runner have to tag up?
What are some of the main baseball pitches?
What were some of Babe Ruth's accomplishments?
What is the Abner Doubleday Theory?
How did World War II affect baseball?

Additional resources

Level I

Buckley, James, Jr. *Play Ball!* Dorling Kindersley, 2002.
Krasner, Steven. *Play Ball Like the Pros.* Peachtree Pubs., 2002.
Ritter, Lawrence S. *The Story of Baseball.* 3rd ed. Morrow, 1999.

Level II

Kindall, Jerry. *Sports Illustrated Baseball: Play the Winning Way.* Rev. ed. Sports Illustrated, 1993.
James, Bill. *The New Bill James Historical Baseball Abstract.* Free Pr., 2001.
Baseball as America. National Geographic Soc., 2002.
Rader, Benjamin G. *Baseball.* 2nd ed. Univ. of Ill. Pr., 2002.
Thorn, John, and others, eds. *Total Baseball: Official Encyclopedia of Major League Baseball.* 7th ed. Total Sports, 2001.
Van Auken, Lance and Robin. *Play Ball: The History of Little League Baseball.* Penn. State Univ. Pr., 2001.

Basel, *BAH zuhl* (pop. 178,428; met. area pop. 406,391), is a major inland port and transportation center in Switzerland. It lies on the Rhine River in the northern part of the country (see **Switzerland** [political map]).

Basel is an important producer of chemicals and a center for banking and insurance. The city also has long been known for its manufacture of dyes, leather goods, and paper. Basel was once a frontier post of the Roman Empire. It has a cathedral founded in 1019. The University of Basel was founded in 1459. Howell C. Lloyd

Basenji, *buh SEHN jee,* is a breed of dogs first found in central Africa. Basenjis cannot bark, but they can make a yodeling sound. They weigh 22 to 24 pounds (10 to 11 kilograms) and have short, silky hair of various colors and pointed ears. There are rows of wrinkles on their foreheads. See also **Dog** (picture: Hounds).

Critically reviewed by the Basenji Club of America

Basie, *BAY see,* **Count** (1904-1984), was a pianist and bandleader who rose to fame in the late 1930's as a key figure in the "swing" era of jazz. Basie's spare, fluent piano style and his loose, informal band arrangements earned him an important place in the history of jazz.

William Basie was born on Aug. 21, 1904, in Red Bank, New Jersey. He was nicknamed "Count" early in his career as a disc jockey. Basie joined Bennie Moten's Kansas City Orchestra in 1929. Basie formed his own band in 1935. In 1935, jazz critic John Hammond arranged for Basie to enlarge the band and take it to New York City. By 1939, the Count Basie Orchestra was world famous. Many outstanding soloists performed with the band. They included saxophonists Lester Young and Herschel Evans, trumpet players Buck Clayton and Harry Edison, trombonist Dickie Wells. His early band featured a famous rhythm section of Walter Page on bass, Freddie Greene on guitar, and Jo Jones on drums. Basie's autobiography, *Good Morning Blues,* was published in 1986, after his death. Gary Giddins

See also **Jazz** (picture: The Count Basie Band).

Basil, *BAZ uhl,* or *BAY zuhl,* is an annual herb used for seasoning food. The *common basil,* also called *sweet basil,* has tooth-edged leaves and small, purplish-white flowers. It grows about 1 foot (30 centimeters) tall. Many other species of basil are grown throughout the world. People use basil leaves in soups, salads, and meats. Basil can be grown from seed. The stalks can be cut and dried for use in the winter. Lyle E. Craker

Scientific classification. Basil makes up the genus *Ocimum* in the mint family, Lamiaceae or Labiatae.

Basil, *BAZ uhl,* **Saint** (330?-379), was a leader in the early Christian church in the East. He was also known as Basil the Great. Basil greatly influenced the development of a form of religious community life called *monasticism.* He established many monastic communities and formulated *rules* (guidelines for monastic life) that are still followed in Eastern Orthodox Churches. Basil also founded hospitals and *hospices,* which are institutions for the care of sick and needy travelers.

Basil was born in Caesarea in Asia Minor (now Kayseri, Turkey), into a wealthy and educated Christian family. Basil lived a life of *asceticism* (self-denial) on his family's estate for five years before being ordained a *presbyter* (elder) in the early Christian church about 362. The Roman Catholic Church celebrates Basil's feast day on January 2. Basil's feast day in the Eastern Orthodox Churches is January 1. Marilyn J. Harran

See also **Religious life** (Religious life in early Christianity).

Basilica, *buh SIHL uh kuh,* was the chief type of church design during the early Middle Ages. The basilica originally was a large hall built by the ancient Romans for administrative and judicial uses. After about A.D. 300's, early Christians adopted the basilica plan for their churches. The layout of medieval cathedrals and most modern churches is derived from Roman and early Christian basilicas.

The typical early Christian basilica had an oblong plan. A person entered at the center of one of the sides into a large central space called the *nave.* A high roof, typically of timber, covered the nave. Aisles covered by lower roofs ran along either side of the nave. A row of columns called a *colonnade* separated the aisles from the nave. An *apse* occupied an area at the far end of the nave. The apse was a large semicircular or polygonal space where the altar was located. William J. Hennessey

See also **Architecture** (Early Christian architecture); **Forum, Roman.**

Basin is a region drained by a river and its *tributaries.* Tributaries are streams or other channels that carry water to a river. The Mississippi River and its tributaries drain a basin that covers about two-fifths of the United

States (excluding Alaska and Hawaii). Other large basins are the Congo in Africa, the Amazon in South America, and the Yangtze in Asia. The boundary between basins is called a *drainage divide*.

A *closed basin* is an area where streams have no outlet to the sea. Water can escape only by evaporating or seeping into the ground. The lowest part is generally occupied by a lake or, in deserts, by a *playa* (dry lake bed). Some closed basins in desert areas have salt lakes, such as the Great Salt Lake in Utah. Wayne Lambert

See also **Great Basin** and the articles in *World Book* on the rivers and lake mentioned in this article.

Baskerville, John (1706-1775), was an English type founder and printer. His taste and care for quality in all departments of book production helped his nation achieve European leadership in that field. After making a fortune in the manufacture of *japanned* (lacquered) ware, Baskerville set out on an ambitious program of printing in 1750. He designed and made his own type. The first book from his press, an edition of Virgil in 1757, amazed readers by its elegance. Baskerville was born in Wolverley, England. Ray Nash

Basket making, or *basketry,* is a popular handicraft. Many people enjoy basket making as a hobby. They create baskets that are useful and decorative. People who make baskets are often called *basket makers.*

Basket making is one of the oldest handicrafts. Since prehistoric times, people have made baskets to use as containers. Prehistoric people wove baskets from grasses and leaves, stalks, and other plant materials. Some early American Indians covered tightly woven baskets with pitch so that the baskets could hold water. Basket-making techniques have also been used to make such objects as dolls, furniture, hats, masks, and saddles. Today, basket makers use many of the same materials and techniques as early people did.

Materials and tools. There are two kinds of basket-making materials—*hard materials* and *soft materials.*

Hard materials include grasses, leaves, plant roots, strips of wood, tree bark, and twigs. These materials may be purchased at a craft shop or gathered from outdoors. A hard material requires special preparation to make it soft, pliable, and strong. First, the material is dried. It usually shrinks and becomes brittle. Next, it is soaked in water so it becomes flexible and workable. The material is then ready to be used. Hard materials must be kept moist during the basket-making process.

Soft materials include yarns and ropes made from such natural fibers as cotton, jute, and wool, or such synthetic fibers as acrylic and nylon. They are available at craft shops in a variety of colors, sizes, and textures.

Few tools are required to make baskets. For working with hard materials, a person may need an awl, a pair of pliers, and a sharp knife or scissors. For soft materials, a large needle and scissors are necessary.

Methods. There are four basic basket-making methods: (1) weaving, (2) twining, (3) plaiting, and (4) coiling. In each method, different strands of material are used to form the *warp* and the *weft* of the basket. The warp consists of foundation strands called *spokes.* The weft is formed by strands that are woven with the spokes of the warp. These strands are called *weavers.*

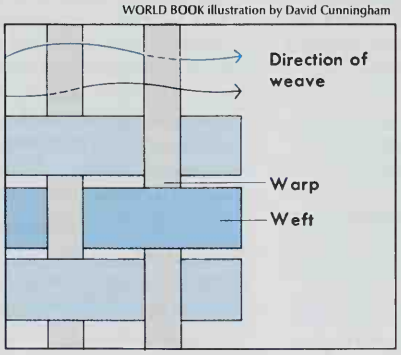
Weaving is the simplest and most common method of making baskets. In this method, the weavers, or the weft, are passed over and under the spokes of the warp. There are three basic weave patterns—called *plain, twill,* and *herringbone.* The plain weave, also called *tabby,* is produced by passing each weaver over one and under one spoke of the warp for each row. In the twill and herringbone weaves, each weaver passes over two and under two spokes all around the row. The twill weave results from starting each new row one spoke to the right or left of the previous row. The herringbone weave is formed by beginning a new row to the right of the previous one, and then the next row to the left. The twill weave forms a diagonal pattern and the herringbone weave a zigzag design.

Combinations of weaves may be used to vary designs of baskets. Different colors of weavers and spokes also result in interesting designs.

The base of a woven basket is made by arranging an uneven number of spokes so that they cross in the center. The weaver is carried under and over, one at a time, around and around. As the weaving progresses, the sides of the basket may be shaped by gradually bending the spokes upright around any object that has the desired shape, such as a box, can, or piece of wood. After the basket is woven, the weft must be secured in a process called *finishing.* One method of finishing a basket is to bend the ends of the spokes over the last weft row and to insert them between the weavers.

Twining resembles plain weaving, but the weavers are used in pairs. One weaver is passed over a spoke, and the other is carried under the same spoke. The weavers cross each other between each spoke. In a finished twined basket, only the weft can be seen. The spokes are completely covered. Twining produces a pleasing, twisted pattern.

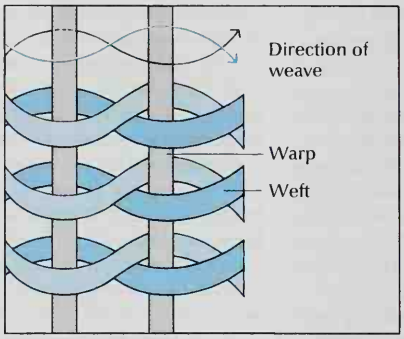
WORLD BOOK illustration by David Cunningham



Weaving is the simplest and most common method of making baskets. These illustrations show a pattern called *plain weave,* also called *tabby.* The basket maker produces this pattern by passing one strand of the weft over and under one strand of the warp in each row.

© Lee Boltin

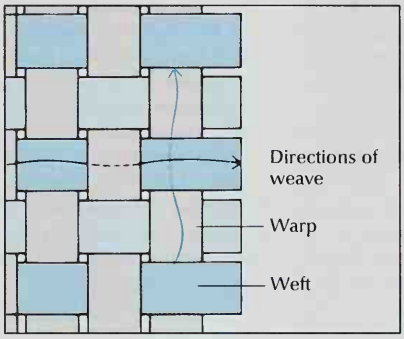
Twining resembles plain weaving, but the basket maker uses the warp strands in pairs. These illustrations show how one strand is passed over a weft, and the other is carried under the same weft. The weft strands cross each other between each pair of warp strands. In a tightly twined completed basket, only the weft can be seen.



WORLD BOOK illustrations by David Cunningham

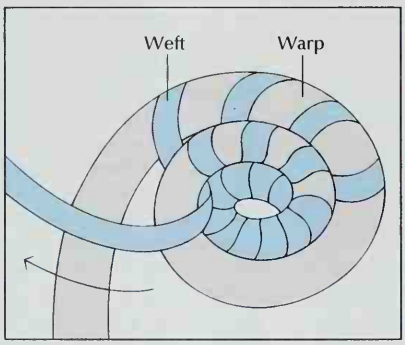
Jerry D. Jacka, Heard Museum

Plaiting is a method in which the warp and the weft are interwoven. As a result, it is often impossible to distinguish between the warp and weft strands in a finished basket. The basket maker must add a rigid rim to the top of a plaited basket so that it keeps its shape.



© Lee Boltin

Coiling is a sewing technique. These illustrations show how the sides are made by winding coils of flexible material on top of each other and binding them together with thread. The base is made by winding coils to form a solid circle. The basket maker wraps each coil and binds it to the one before it.



Museum of the American Indian (Carmelo Guadagno)

Plaiting. In plaiting, the weavers and the spokes are interwoven and may be of the same material. As a result, a person may be unable to distinguish between the weft and warp in a plaited basket. A majority of plaited baskets are made of flat materials, such as strips of leaves, paper, ribbons, or wood. They generally are not as sturdy as woven baskets. A basket maker must add a rigid rim to the top of a plaited basket so that it keeps its shape.

Coiling is a sewing technique. The basket begins from a core that winds around in a circle and forms a coil. The coils of the basket are held together by a binding thread. Flexible materials are needed for the basket coils, such as grass, rope, straw, twigs, or yarn. Fine, thin materials, such as raffia, strips of cornhusks, yarn, string, or rope, are commonly used for the binding thread.

The base of a coiled basket is made by winding a number of coils to form a solid circle. As each coil progresses, it is wrapped and bound to the one before it. The sides of the basket are made by winding coils on top of one another and binding them together. This winding process is continued until the basket reaches the desired height. Dona Z. Meilach

See also **Indian, American** (pictures); **Wicker.**

Additional resources

Doney, Meryl. *Baskets.* Watts, 1997. Younger readers.
Johnson, Kay. *Basketmaking.* Batsford, 1993.
Schiffer, Nancy N. *Baskets.* Rev. ed. Schiffer, 1996.
Turnbaugh, Sarah P. and W. A. *Indian Baskets.* 1986. Reprint. Schiffer, 1997.

© Jamie Squire, Getty Images

Basketball is a fast-paced sport that requires teamwork, speed, and endurance. Millions of fans each year attend games in arenas and gymnasiums to cheer for their favorite teams. Basketball is popular at the high school, college, and professional level with both males and females.

Basketball

Basketball is a fast, exciting, and entertaining sport played between two teams, each consisting of five players. A team wins games by scoring more points than the opposing team. Players score by shooting a large inflated ball into a raised goal, called a *basket,* at one end of a basketball court. A player can advance the ball toward the basket only by *dribbling* (bouncing the ball) or by passing to a teammate. Each team also tries to prevent the other team from scoring.

Basketball was invented in the United States in 1891. By the mid-1900's, it had become the world's most popular indoor sport. Today, millions of fans crowd into gymnasiums and arenas to watch their favorite teams. Millions more watch games on television. In the United States, thousands of elementary schools, high schools, and colleges and universities sponsor amateur teams for male and female players. The finest male players in the world compete as professionals in the National Basketball Association (NBA).

Basketball is a popular form of recreation as well as an organized team sport. Park districts, religious organizations, and youth centers sponsor recreational leagues. A majority of schools sponsor intramural competition. Both young people and adults enjoy playing on neighborhood playgrounds, in backyards, in alleys, and on driveways. As few as two players can play; all they need is a ball, a basket, and a level surface to serve as the court.

Basketball requires teamwork, quick reactions, and endurance. Tall players have an advantage because they can reach closer to the basket or above other players to shoot and rebound. However, smaller players also make contributions to their teams as shooters and ball handlers.

This article deals chiefly with basketball as played in the United States. The game differs somewhat in other countries. The section *International competition* describes some of the differences.

John R. Thompson, Jr., the contributor of this article, is the former Head Basketball Coach at Georgetown University in Washington, D.C.

How to play basketball

The court. A regulation basketball court measures 94 feet (29 meters) long and 50 feet (15 meters) wide. Courts for high school games may be 84 feet (26 meters) long. Most courts are made of wood. Various lines, 2 inches (5 centimeters) wide, mark off the court into sections. For the names of these lines and the sizes and the names of the sections, see the diagram of a court in this article.

A *basket* and a *backboard* hang over each end of the court. Each backboard must be 4 feet (122 centimeters) inside the end line. The basket consists of a rim, net, and

backboard support. The rim is a cast-iron hoop 18 inches (46 centimeters) in diameter and not over $\frac{5}{8}$-inch (16 millimeters) thick. The rim is attached to a metal plate shaped like an upside-down L that is bolted to the backboard so it is parallel to the floor and 10 feet (3 meters) above it. Backboards are made of clear fiberglass or metal. High school teams use fan-shaped or rectangular backboards. In college and NBA games, rectangular backboards are used. The cotton or synthetic fabric net is attached to the rim and has a hole in the bottom large enough for the ball to drop through.

Equipment. Basketball is played with a round brown or orange inflated leather ball. The ball for boys' and men's games weighs between 20 and 22 ounces (567 to 624 grams) and is about 30 inches (75 centimeters) in circumference. Girls and women use a ball that weighs between 18 and 20 ounces (510 to 567 grams) and is about 29 inches (74 centimeters) in circumference.

The standard basketball uniform consists of a sleeveless shirt, shorts, white socks, and lightweight canvas or leather shoes with rubber soles. The shirt and shorts are lightweight cotton or polyester. Each jersey has a number on the front and back so the player can be easily identified by the officials and spectators. Many college and all professional players have their last name on the back of the jersey with the name of the team on the front. The home team usually wears light-colored uniforms and the visiting team wears a darker color.

The players. The five players on a team play both offense and defense. When their team has the ball, they are *on offense;* when their opponents have the ball, they are *on defense.* Because possession of the ball can change rapidly, all players must be alert so that they can quickly switch between offense and defense.

Normally, a team consists of two guards, two forwards, and a center. However, players can move anywhere on the court at any time, no matter what their position. A team can also vary the positions at any time, for example, playing three guards and two forwards. This section describes the role of each position on offense.

MacGregor ® Sporting Goods

The basketball is round and made of orange or brown leather with a pebble grain. The ball shown above is used for boys' and men's games. Girls and women play with a slightly smaller ball.

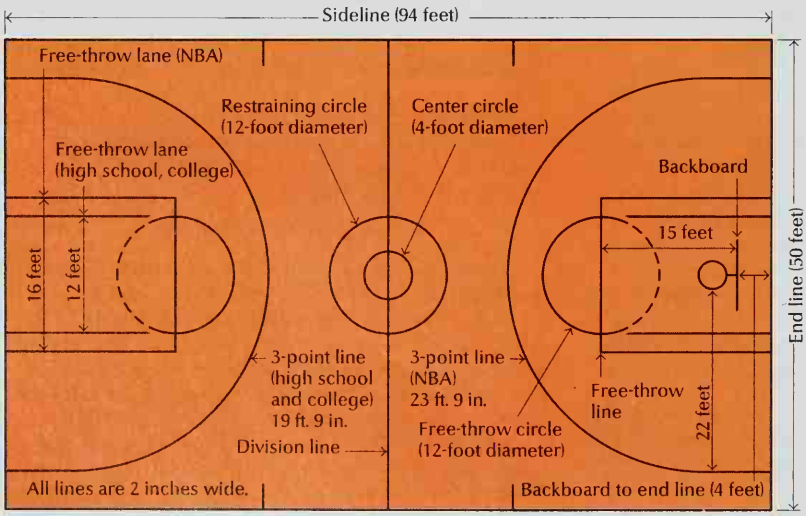
The guards are usually the smallest and quickest players. They normally play farther from the basket than the forwards or center. Guards should be good dribblers and passers. They direct the offense and start most of the plays. Some teams have a *point guard,* who has the major ballhandling responsibilities. The other guard is the *shooting guard* and is often the team's best shooter.

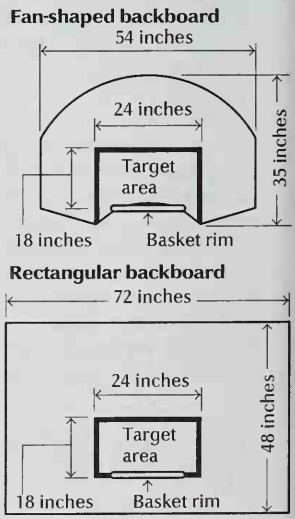
Forwards are generally taller and stronger than guards. Forwards usually play in the area from the base line to the free throw lane. They should be good re-

Diagrams of a court and backboards

A basketball court is a rectangle divided into halves by a division line. Other lines further divide the court into sections. A backboard and basket hang over each end. High school teams use fan-shaped or rectangular backboards. College and professional teams use rectangular ones.

WORLD BOOK diagrams





Basketball terms

Assist is a pass by an offensive player that leads directly to a basket.
Backcourt is the defensive team's half of the court.
Blocked shot occurs when a defensive player legally hits a shot with the arm or hand before the ball reaches the basket.
Dunk is a field goal made by slamming the ball through the basket from above the rim.
Front court is the offensive team's half of the court.
Goaltending is illegally interfering with the flight of a field goal attempt when the ball is above the basket. If goaltending is called on the defense, the shot is scored as a field goal. If goaltending is called on the offense, the defensive team is awarded possession of the ball and no points are scored.
Held ball is a ball in the possession of a player from each team at the same time. In high school and college games, one team gains possession of the ball after a held ball is called. The other team gets possession following the next held ball. In the NBA, possession of the ball is determined by a jump ball between the two players.
Lay-up is a shot taken close to the basket.
Post is another name for the position the center plays on offense. In a *high post,* the center plays near the top of the free throw circle. In a *low post,* the center plays near the basket.
Rebound is a ball that bounces back off the backboard or rim after a shot has been missed.
Steal occurs when a defensive player legally takes possession of the ball from the offense, such as by intercepting a pass.
Three-point play occurs when a player is fouled while making a basket and then makes the free throw. A *three-point shot* occurs when a player scores a basket while shooting from behind a special 3-point line.
Tip-in is a field goal made by tipping a rebound into the basket, usually with the fingers of one hand.
Turnover occurs when the offensive team loses possession of the ball without taking a shot.

bounders and be able to maneuver for shots close to the basket. The center is usually the team's tallest player and best rebounder. Center is the most important position on the team. A center who is a good rebounder and scorer can dominate a game.

The coach is a basketball team's teacher. Most college and professional teams have one or more assistant coaches who help the coach work with the team. Together, they make up the *coaching staff.*

The coach organizes practice sessions to prepare the team for each game. He or she selects the players who will start the game. During the game, the coach substitutes players, trying to use those players who perform best in certain situations. The coach decides when the team needs a time out, and determines what type of offense and defense will be most effective.

A coach must analyze the opposing team, determining its strengths and weaknesses. Often an assistant coach will *scout* (watch) a game involving an upcoming opponent and report back to the coach on the best strategy for playing the team.

The officials consist of a referee, one or two umpires, one or two scorekeepers, and one or two timekeepers. The referee is in charge of the game. The referee and umpires operate on the court to ensure that the game is played by the rules. They both can call any foul or violation they see anywhere on the court.

Usually, one official operates near the offensive team's basket and the other near the division line. The officials reverse positions when the teams move to the other end of the court. If a second umpire is used, he or she stands near a sideline. To call a violation or foul, the official blows a whistle to stop play and the clock. The official explains the violation or foul, usually with a hand or arm signal, and enforces the penalty. The game then resumes

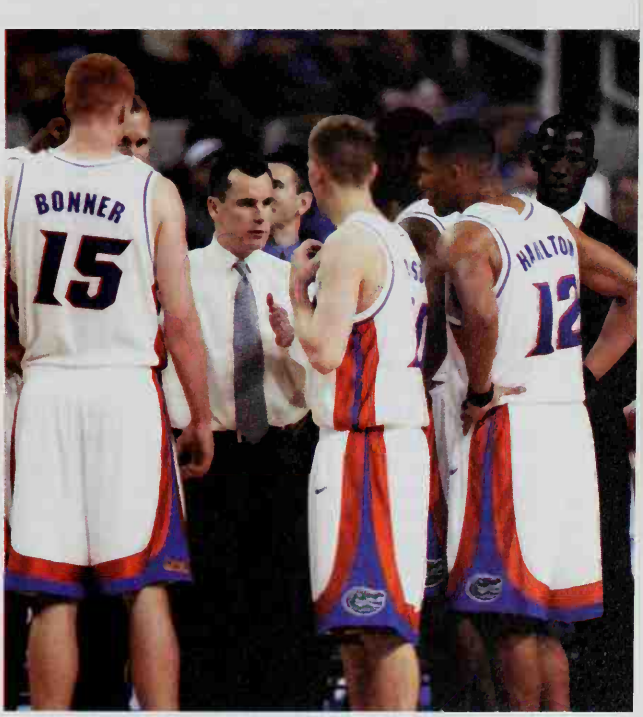
The scorekeepers and timekeepers sit at a table behind one of the sidelines. One scorekeeper operates the electronic scoreboard. The other scorekeeper keeps the official scorebook, recording all the field goals, free throws, fouls, and time outs. One timekeeper operates the electric game clock. A second one operates the shot clock if the rules call for each team to shoot within a given time limit.

Players entering the game must first report to the scorekeeper in charge of the scorebook. The timekeeper must stop the clock every time the referee or umpire blows the whistle. One of the officials will signal the timekeeper when to restart the clock.

Playing time. High school games last 32 minutes. They are divided into two 16-minute halves, each consisting of two 8-minute quarters. The teams take a 1-minute break at the end of the first and third quarters and a 10-minute break between halves. College teams play two 20-minute halves, with a 15-minute break between halves.

NBA teams play four 12-minute quarters. They take a 1 $\frac{1}{2}$-minute break between quarters and a 15-minute break between halves. A game clock located above the court shows the time remaining in a half or quarter.

If the score is tied at the end of regulation time, teams

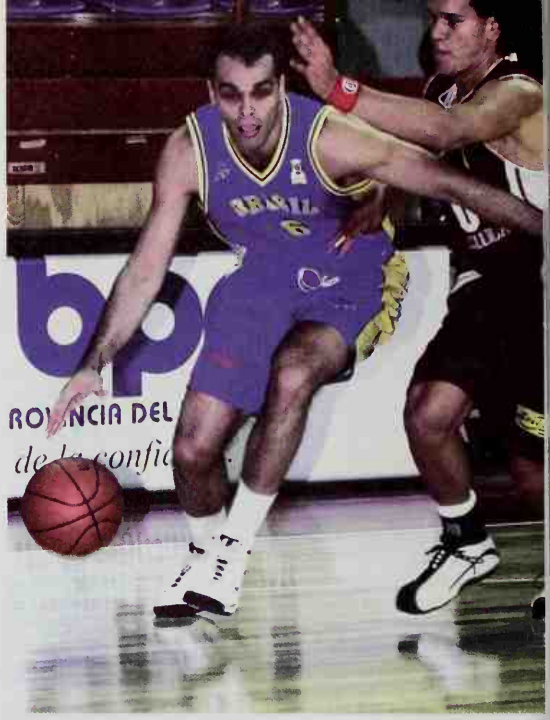


© Jamie Squire, Getty Images

The coaching staff prepares a team for each game and determines offensive and defensive strategy during the game. This coach is giving instructions to his team during a time out.

© ELSA, Getty Images

A jump ball starts a basketball game. The referee tosses the ball straight up into the air. One player from each team jumps inside the center circle and tries to tap the ball to a teammate.



AP/Wide World

Dribbling is an important offensive skill. A good dribbler can move past a defender for an easy shot or set up a teammate for a shot. A team's guards generally do most of the dribbling.

play as many overtime periods as needed to determine a winner. High school teams play 4-minute overtimes. College and NBA teams play 5-minute overtimes.

Play is stopped if an official calls a foul or violation, if the ball goes out of bounds, and if a team calls a time out. The game may also be stopped if a player is injured or if the officials determine that spectators are interfering with the normal progress of the game.

High school teams are permitted four time outs during a game. College teams may call five time outs, plus one additional time out for each overtime period. If a college game is televised, each team is permitted only three time outs during regulation play. In addition, at least three time outs may be called for TV commercials. The NBA permits seven 90-second time outs during a game. Each team is also allowed one 20-second time out each half. However, a pro team may call no more than four time outs during the fourth quarter.

Scoring. A team scores points by making field goals and free throws. A field goal may be attempted from anywhere on the floor by any offensive player while the game clock is running. Field goals are worth 2 points if they are taken inside a 3-point line. Field goals made from behind this line count 3 points.

Free throws count 1 point each and are taken as a penalty after certain fouls. A player attempts a free throw from behind the free throw line and inside the free throw circle. Players have 10 seconds to shoot after the official hands them the ball.

Playing the game. A game starts with the center jump. Four players from each team stand outside the restraining circle. The fifth player, usually the center, stands inside the center circle. The official tosses the ball into the air above the two players, who jump up and try to tap it to a teammate. The game clock starts as soon as a player touches the ball.

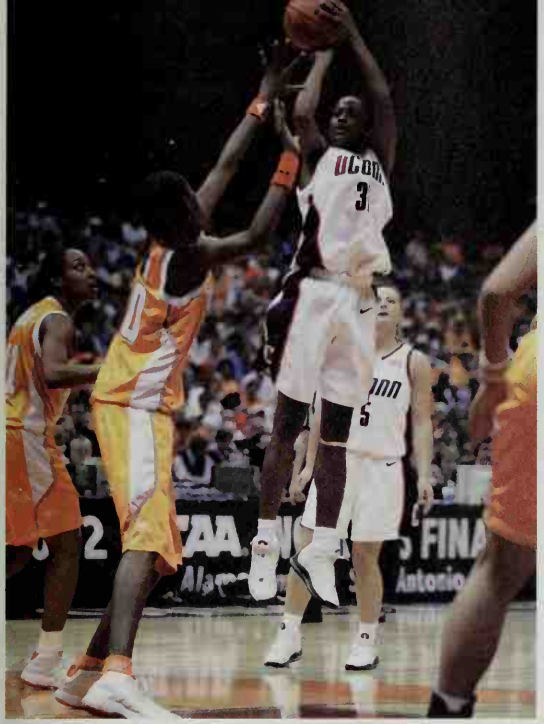
Once it gains possession of the ball, the offensive team advances the ball into the front court. The team can dribble the ball or pass it. If the offensive team scores, the opposing team immediately takes the ball out-of-bounds from behind the base line and tries to move the ball to the basket at the other end of the court. It becomes the offensive team and the team that just scored becomes the defensive team. Action continues in this manner until the clock is stopped.

If a player misses a shot, both teams try to gain possession of the ball by catching the rebound. All missed field goal attempts and most missed free throw attempts result in rebounds. Rebounding is a vital part of the game. Most teams miss at least half their shots. Therefore, a strong rebounding team can control the ball more and has more scoring opportunities.

Offensive strategies try to free a player for a good scoring opportunity. The offense may run plays that require a number of passes and constant movement by the five players. A successful play will produce a good shot or cause a defender to commit a foul. Players may set a *screen* or *pick* to free a teammate for a shot. In a screen or pick, an offensive player legally blocks a defensive player with his or her body so the defensive player cannot guard the player with the ball. That player can then take an open shot.

The *fast break* is designed to score quickly after the offensive team gains possession of the ball. The offense tries to get at least one of its players ahead of the defense for an easy shot before the defenders can move into proper position.

The *delay* is an offensive strategy that is primarily de-



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The jump shot is the most common shot in basketball. The shooter jumps straight up and releases the ball at the peak of the jump. The shot can be released quickly and is difficult to block.

© John Mabanglo, Corbis

The dunk is one of basketball's most exciting shots. The shooter slams the ball through the basket from above the rim. Many dunks are unguarded shots that come at the end of a fast break.

signed to use up time, rather than to score. Teams will often use a delay to protect a lead late in the game, passing and dribbling to keep the ball away from the other team.

Defensive strategies. There are two types of team defense, *zone* and *man-to-man*. In a zone defense, each player is assigned a particular area of the front court to defend. In man-to-man defense, each player guards a particular offensive player on all parts of the court.

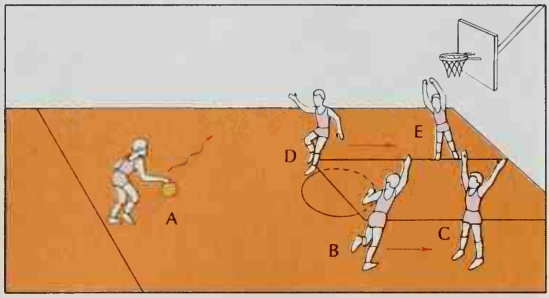
One variation of the two defenses is the *press*. The press is designed to put defensive pressure on the offensive team all over the court. The press tries to force the offensive team into a *turnover* (losing possession of the ball). Pressing defenses often use a tactic called the *trap* or *double-team*. In a trap, two defensive players suddenly converge on the player with the ball, trying to force that player into making a turnover.

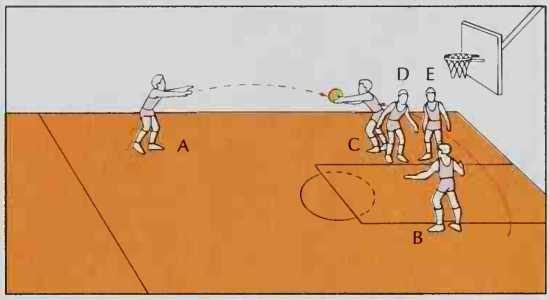
Fouls are called by officials. Players may commit either a *personal foul* or a *technical foul*.

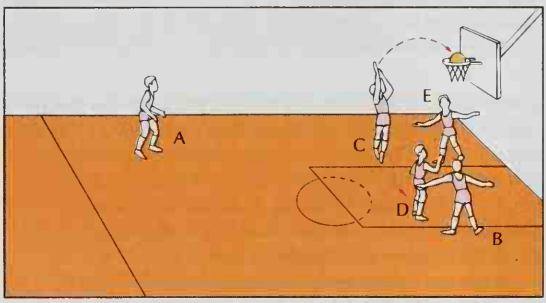
The more common type of foul is the personal foul.

© Brian Bahr, Getty Images

A free throw is shot from behind a line in the free throw circle. Players from both teams line up along the free throw lane. They cannot step into the lane until the shooter releases the ball. If the shooter misses the free throw, the other players try to get the rebound.







WORLD BOOK illustrations by Bill and Judie Anderson

Offensive plays are often designed to create a good shot for a particular player. The play shown here is intended to free player C for a shot. Player A dribbles to his left and passes the ball to player C, who has moved across the free throw lane.

Most personal fouls occur when a player holds, pushes, or charges into an opponent, or hits the arm or body of an opponent who is in the act of shooting. A player fouled in the act of shooting gets two free throws if the shot was missed and one if it was made. In college and NBA games, a player receives three free throws if fouled while attempting and missing a 3-point shot and one if the shot is good. If the fouled player is on the offensive team but not shooting, his or her team retains possession of the ball.

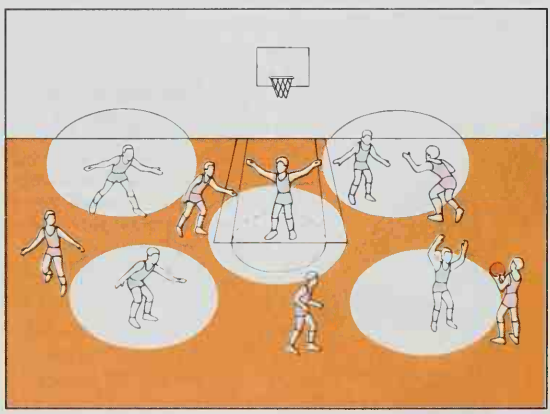
A team goes into the *penalty situation* after committing a certain number of personal fouls in a quarter or half. The fouled team then shoots one or two free throws after every foul for the rest of that quarter or half. In high school games, the fouled player is awarded a free throw beginning with the fifth foul committed by the opposing team each half. If the player makes the free throw, a second shot is awarded. This situation is called the *one-and-one*. In college games, the one-and-one begins with the seventh foul on the opposing team. Two free throws are awarded after the 10th foul in each half. If a player commits a foul while in possession of the ball, no free throws are awarded. Instead, the other team gets possession of the ball. This type of foul is called an *offensive* or *player controlled foul* and does not count toward the penalty situation. All other fouls count toward the penalty situation and are called *team fouls*.

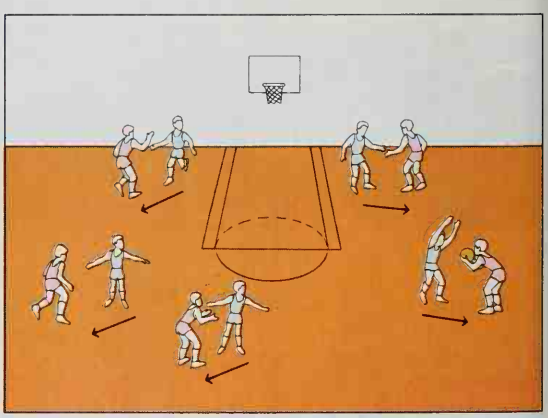
In the NBA, the fouled player shoots two free throws beginning with the opposing team's fifth team foul in each quarter. In addition, a fouled player gets two free throws if the offending team has committed more than one team foul in the last two minutes of a quarter.

In any competition, if an official decides that a player has committed a *flagrant* (intentional) *foul*, the fouled player gets two free throws. In the NBA, the fouled team also retains possession of the ball.

A high school or college player is disqualified from a game after committing five personal fouls. In college games, certain technical fouls count toward player disqualification and the penalty situation. In the NBA, disqualification comes after six personal fouls.

A technical foul may be called on any player or coach. Most technical fouls are called for unsportsmanlike con-





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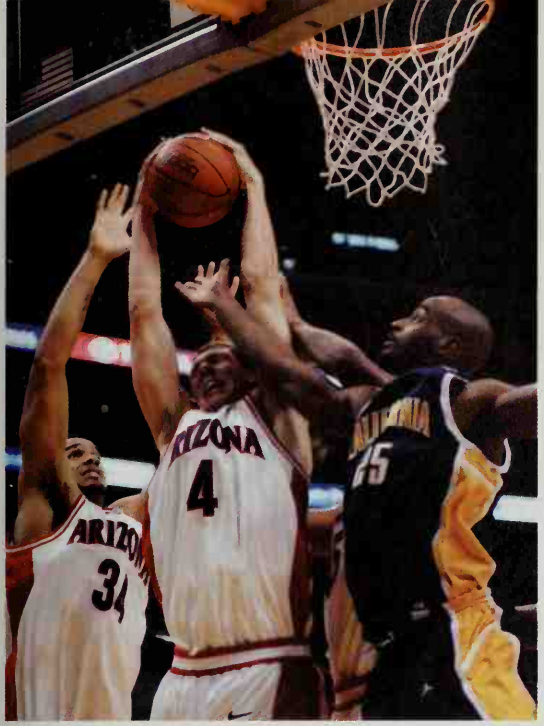
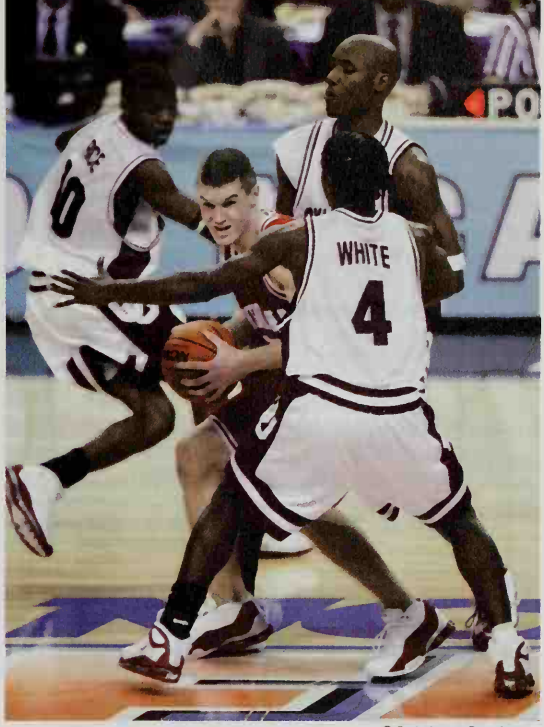
Defensive systems include the zone defense, *left*, and the man-to-man defense, *right*. The zone is designed to give each defensive player a certain area of the court to guard. In a man-to-man defense, defensive players are assigned specific opponents and follow them in the forecourt.



© Harry How, Getty Images

Rebounds occur after field goal attempts and most missed free throws. Players try to capture rebounds by positioning themselves close to the basket with their opponents behind them.

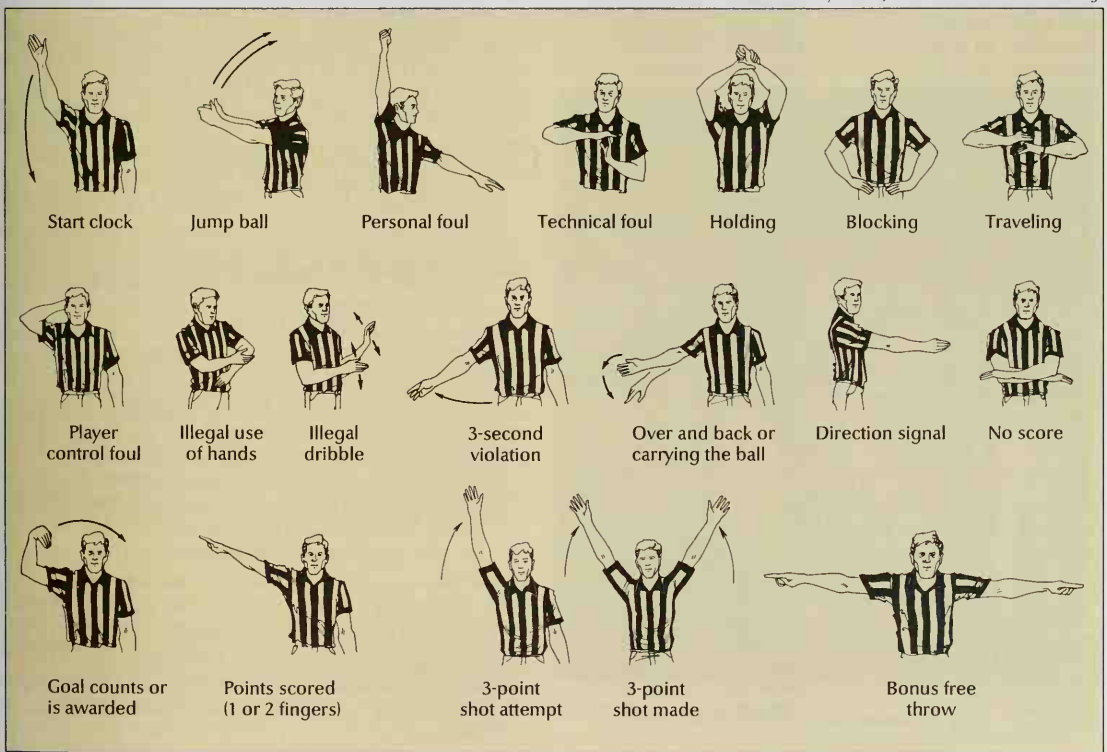


© Craig Jones, Getty Images

The trap is a defensive tactic in which two or more defenders closely guard the ballhandler. The trap is designed to force the offensive player to make a bad pass or to commit a turnover.

Officials' signals Officials use hand signals to inform players and spectators of violations and other actions during a game. Any official can make a call and give the signal. Most signals are the same in high school, college, and professional games. the most common ones are shown here.

WORLD BOOK illustrations by Bill and Judie Anderson and Paul D. Turnbaugh



duct toward the officials. In high school and college games, if a player or someone on the bench is charged with a technical foul, the opponent gets two free throws. In high school games, the opponent also gets possession of the ball. A player or coach called for two technical fouls is disqualified from the game. The coach is also disqualified if three technicals are assessed against the bench. In the NBA, one free throw is awarded for a technical foul. The team with the ball at the time of the foul keeps the ball. Two technicals against a coach or player results in disqualification.

Violations are usually committed by the offensive team. The penalty for most violations is loss of possession of the ball. The most common violations result from ball-handling errors. For example, an official calls a violation for an illegal dribble when the player bounces the ball with both hands at the same time, or when he or she stops dribbling and then starts again.

A number of violations result from time restrictions. For example, a team must get the ball in play from out-of-bounds within 5 seconds. Officials call a violation if any offensive player stands in the front court free throw lane for over 3 seconds. In high school and men's college games, the team must move the ball across the division line within 10 seconds or a violation is called. In the NBA, teams have 8 seconds. The offensive team also commits a violation if it takes the ball into the back court after crossing the division line. In high school and college games, the offensive team commits a violation if a closely guarded player holds or dribbles the ball in the front court for more than 5 seconds. In women's college games, a closely guarded player commits a violation by holding the ball more than 5 seconds anywhere on the court.

In college and NBA competition, a team commits a violation if it fails to shoot within a certain time. A special shot clock at each end of the court keeps track of the time. College men's teams must shoot within 35 seconds. In women's college basketball, the limit is 30 seconds. NBA teams must shoot within 24 seconds.

NCAA basketball champions

Men

1938-1939	Oregon	**1972-1973**	UCLA
1939-1940	Indiana	**1973-1974**	North Carolina State
1940-1941	Wisconsin		
1941-1942	Stanford	**1974-1975**	UCLA
1942-1943	Wyoming	**1975-1976**	Indiana
1943-1944	Utah	**1976-1977**	Marquette
1944-1945	Oklahoma A&M	**1977-1978**	Kentucky
1945-1946	Oklahoma A&M	**1978-1979**	Michigan State
1946-1947	Holy Cross	**1979-1980**	Louisville
1947-1948	Kentucky	**1980-1981**	Indiana
1948-1949	Kentucky	**1981-1982**	North Carolina
1949-1950	CCNY	**1982-1983**	North Carolina State
1950-1951	Kentucky		
1951-1952	Kansas	**1983-1984**	Georgetown
1952-1953	Indiana	**1984-1985**	Villanova
1953-1954	La Salle	**1985-1986**	Louisville
1954-1955	San Francisco	**1986-1987**	Indiana
1955-1956	San Francisco	**1987-1988**	Kansas
1956-1957	North Carolina	**1988-1989**	Michigan
1957-1958	Kentucky	**1989-1990**	Nevada-Las Vegas
1958-1959	California		
1959-1960	Ohio State	**1990-1991**	Duke
1960-1961	Cincinnati	**1991-1992**	Duke
1961-1962	Cincinnati	**1992-1993**	North Carolina
1962-1963	Loyola (Ill.)	**1993-1994**	Arkansas
1963-1964	UCLA	**1994-1995**	UCLA
1964-1965	UCLA	**1995-1996**	Kentucky
1965-1966	Texas Western	**1996-1997**	Arizona
1966-1967	UCLA	**1997-1998**	Kentucky
1967-1968	UCLA	**1998-1999**	Connecticut
1968-1969	UCLA	**1999-2000**	Michigan State
1969-1970	UCLA	**2000-2001**	Duke
1970-1971	UCLA	**2001-2002**	Maryland
1971-1972	UCLA		

Women

1981-1982	Louisiana Tech	**1992-1993**	Texas Tech
1982-1983	Southern California	**1993-1994**	North Carolina
1983-1984	Southern California	**1994-1995**	Connecticut
1984-1985	Old Dominion	**1995-1996**	Tennessee
1985-1986	Texas	**1996-1997**	Tennessee
1986-1987	Tennessee	**1997-1998**	Tennessee
1987-1988	Louisiana Tech	**1998-1999**	Purdue
1988-1989	Tennessee	**1999-2000**	Connecticut
1989-1990	Stanford	**2000-2001**	Notre Dame
1990-1991	Tennessee	**2001-2002**	Connecticut
1991-1992	Stanford		

Basketball competition

High school competition. More high schools in the United States participate in basketball than in any other sport. Some states divide their high schools into classes based on enrollment. In a few states, private schools and public schools conduct separate championship tournaments. Some large cities, such as Philadelphia and Chicago, hold their own championship tournaments.

College competition. Most U.S. colleges and universities belong to the National Collegiate Athletic Association (NCAA). About 750 schools in the NCAA sponsor men's basketball teams, and about 550 sponsor women's teams. The teams with the largest enrollment compete in Division I. The smaller schools compete in Division II or Division III. About 500 other schools with small enrollments belong to the National Association of Intercollegiate Athletics (NAIA), which conducts both men's and women's basketball competition.

Most schools in the NCAA and NAIA belong to one of

National Basketball Association

Eastern Conference

Atlantic Division	**Central Division**
Boston Celtics	Atlanta Hawks
Miami Heat	Chicago Bulls
New Jersey Nets	Cleveland Cavaliers
New York Knickerbockers	Detroit Pistons
Philadelphia 76ers	Indiana Pacers
Orlando Magic	Milwaukee Bucks
Washington Wizards	New Orleans Hornets
	Toronto Raptors

Western Conference

Midwest Division	**Pacific Division**
Dallas Mavericks	Golden State Warriors
Denver Nuggets	Los Angeles Clippers
Houston Rockets	Los Angeles Lakers
Memphis Grizzlies	Phoenix Suns
Minnesota Timberwolves	Portland Trail Blazers
San Antonio Spurs	Sacramento Kings
Utah Jazz	Seattle SuperSonics

over 100 college conferences. Most conferences consist of teams in the same geographical area. A number of them are also major football conferences (see **Football** [table: Major college football conferences]).

The NCAA championships are determined by a round of play-offs that begin after the end of the regular season. Sixty-five teams are selected to compete in the men's Division I tournament. The 64th and 65th teams play a game after the end of the regular season with the winner qualifying for the tournament. The men's Division II championships begin with 32 teams and Division III, with 40 teams. The NCAA women's championship starts with 64 teams for Division I and 32 teams for Division II and Division III. The NAIA also holds a national tournament.

The Metropolitan Intercollegiate Basketball Association of New York City sponsors the National Invitation Tournament (NIT). Separate tournaments are held before and after the regular season. The association selects Division I teams from throughout the United States to compete.

Almost 500 junior colleges sponsor men's teams, and about 400 sponsor women's teams. The National Junior College Athletic Association holds an annual championship tournament.

Professional competition. The National Basketball Association is the world's leading professional basketball league. The NBA consists of 29 teams divided into two conferences and four divisions. Each team plays an 82-game schedule. After the regular season ends, the eight teams in each conference with the best records qualify for the championship play-offs.

NBA teams obtain new players through an annual draft of former college and high school players and players from other countries. Teams with the poorest records pick first, and the NBA champion picks last.

There is one women's professional league, called the Women's NBA. It is owned by the NBA and began competition in 1997.

International competition. Basketball has become a popular amateur and professional sport in countries throughout the world. Both men's and women's basketball are sports in the Summer Olympic Games.

International rules are basically the same as American rules. However, there are a few important differences. For example, teams must shoot within 30 seconds after gaining possession of the ball. Once a shot hits the rim, both offensive and defensive players may touch the ball no matter what its position. Such an action would result in a goaltending violation in the United States. Teams go into the penalty situation after committing seven personal or technical fouls in a half. Until a team reaches the penalty situation, the opponents receive possession of the ball after being fouled. Beginning with the 11th foul, the fouled team may shoot two free throws or gain possession of the ball. Markings on the court are also somewhat different in international competition.

Men's professional basketball leagues thrive in France, Israel, Italy, Spain, and Yugoslavia. The league season in most European countries consists of about 40 games, about half the length of the NBA season. Some European-born players compete in the NBA.

Nearly 2,000 Americans play professional basketball outside the United States, including several who once played in the NBA. Most European teams are limited to two Americans on their roster. Americans may also receive such additional benefits as rent-free living quarters, the use of an automobile, and paid trips home. Some Americans have used the option of playing in Europe as a salary-bargaining tactic when dealing with NBA teams.

The history of basketball

Beginnings. James Naismith, a Canadian, invented basketball in 1891. Naismith was a physical-education instructor at the School for Christian Workers (now Springfield College) in Springfield, Massachusetts. Luther H. Gulick, head of the school's physical-education department, asked Naismith to create a team sport that could be played indoors during the winter.

For his new game, Naismith decided to use a soccer ball because it was large enough to catch easily. He then asked the building superintendent for two boxes to use as goals. The superintendent had no boxes but provided two peach baskets. The baskets were attached to a gymnasium balcony railing located 10 feet (3 meters) above the floor. The first game took place between members of Naismith's physical-education class in December 1891. After the first experimental game, Naismith drafted the original 13 rules of the game. They appeared in the school newspaper on Jan. 15, 1892. Soon basketball was being played by YMCA, high school, college, and professional teams in the United States and Canada.

Changes in the game. In 1893, metal hoops with net bags attached replaced the wooden baskets. Officials pulled a cord attached to the net to let the ball drop out. Baskets with bottomless nets came into general use about 1913. The backboard was introduced in 1894. That year, larger balls replaced soccer balls.

UPI Bettmann Archive

The first important intersectional game was played in 1934 in New York City. More than 16,000 spectators watched New York University defeat Notre Dame, 25-18.

In 1932, the *10-second* rule was adopted. This rule stated that the offensive team must advance the ball across the division line within 10 seconds or lose possession. Once the ball crossed the line, the offensive team lost possession if a player took the ball back over the line. Until 1937, a center jump was held after every field goal. Beginning in 1937, the defensive team received the ball out-of-bounds after a field goal.

In 1935, a rule was adopted that prohibited any offensive player from standing in the free throw lane for more than three seconds. In 1955, the foul lane was widened to 12 feet (3.7 meters) from the previous 6 feet (1.83 meters). These changes resulted in more offensive movement and less physical contact near the basket.

Early basketball had little scoring. Players basically used two shots, the lay-up and a two-handed set shot. Hank Luisetti revolutionized the game by popularizing a one-handed shot. Luisetti was a star for Stanford University from 1935 to 1938. His one-handed shot could be released quicker than the two-handed shot and was more difficult to defend.

The one-handed shot was the most popular shot in basketball until Joe Fulks popularized the *jump shot.* Fulks played for the Philadelphia Warriors of the NBA from 1946 to 1954. To shoot, he jumped up and released the ball at the peak of his jump. The jump shot was even more accurate and difficult to defend against than the one-handed shot. The jump shot became the most popular shot in basketball and greatly increased scoring.

The history of college basketball. The first college game using five-player teams took place in Iowa City, Iowa, on Jan. 16, 1896. The University of Chicago defeated the University of Iowa, 15-12.

During the game's early days, colleges played teams in their own area. Travel was too difficult and too expensive to allow frequent games between schools from different sections of the country. Instead, teams in a region formed conferences. The Ivy League, the oldest conference still in existence, was established for the 1901-1902 season.

The first important intersectional game took place in 1934. The University of Notre Dame played New York University in Madison Square Garden in New York City as part of a double-header that attracted more than 16,000 fans and marked the beginning of intersectional basketball on a regular basis. The first national tournament, the NIT, was held at the end of the 1937-1938 season. Temple University won the first title. The University of Oregon won the first NCAA tournament, held after the 1938-1939 season.

After the end of World War II in 1945, a number of developments helped spread the popularity of college basketball. Schools built large arenas for games, increasing attendance. Many games were shown on television. The revenue from greater attendance and from television enabled schools to offer athletic scholarships to players. Many young athletes turned to basketball in the hope of winning a scholarship.

National Basketball Association play-off champions

Season	Winner	Loser	Wins-losses
1946-1947*	Philadelphia Warriors	Chicago Stags	4-1
1947-1948*	Baltimore Bullets	Philadelphia Warriors	4-2
1948-1949*	Minneapolis Lakers	Washington Capitols	4-2
1949-1950	Minneapolis Lakers	Syracuse Nationals	4-2
1950-1951	Rochester Royals	New York Knickerbockers	4-3
1951-1952	Minneapolis Lakers	New York Knickerbockers	4-3
1952-1953	Minneapolis Lakers	New York Knickerbockers	4-1
1953-1954	Minneapolis Lakers	Syracuse Nationals	4-3
1954-1955	Syracuse Nationals	Fort Wayne Pistons	4-3
1955-1956	Philadelphia Warriors	Fort Wayne Pistons	4-1
1956-1957	Boston Celtics	St. Louis Hawks	4-3
1957-1958	St. Louis Hawks	Boston Celtics	4-2
1958-1959	Boston Celtics	Minneapolis Lakers	4-0
1959-1960	Boston Celtics	St. Louis Hawks	4-3
1960-1961	Boston Celtics	St. Louis Hawks	4-1
1961-1962	Boston Celtics	Los Angeles Lakers	4-3
1962-1963	Boston Celtics	Los Angeles Lakers	4-2
1963-1964	Boston Celtics	San Francisco Warriors	4-1
1964-1965	Boston Celtics	Los Angeles Lakers	4-1
1965-1966	Boston Celtics	Los Angeles Lakers	4-3
1966-1967	Philadelphia 76ers	San Francisco Warriors	4-2
1967-1968	Boston Celtics	Los Angeles Lakers	4-2
1968-1969	Boston Celtics	Los Angeles Lakers	4-3
1969-1970	New York Knickerbockers	Los Angeles Lakers	4-3
1970-1971	Milwaukee Bucks	Baltimore Bullets	4-0
1971-1972	Los Angeles Lakers	New York Knickerbockers	4-1
1972-1973	New York Knickerbockers	Los Angeles Lakers	4-1
1973-1974	Boston Celtics	Milwaukee Bucks	4-3
1974-1975	Golden State Warriors	Washington Bullets	4-0
1975-1976	Boston Celtics	Phoenix Suns	4-2
1976-1977	Portland Trail Blazers	Philadelphia 76ers	4-2
1977-1978	Washington Bullets	Seattle SuperSonics	4-3
1978-1979	Seattle SuperSonics	Washington Bullets	4-1
1979-1980	Los Angeles Lakers	Philadelphia 76ers	4-2
1980-1981	Boston Celtics	Houston Rockets	4-2
1981-1982	Los Angeles Lakers	Philadelphia 76ers	4-2
1982-1983	Philadelphia 76ers	Los Angeles Lakers	4-0
1983-1984	Boston Celtics	Los Angeles Lakers	4-3
1984-1985	Los Angeles Lakers	Boston Celtics	4-2
1985-1986	Boston Celtics	Houston Rockets	4-2
1986-1987	Los Angeles Lakers	Boston Celtics	4-2
1987-1988	Los Angeles Lakers	Detroit Pistons	4-3
1988-1989	Detroit Pistons	Los Angeles Lakers	4-0
1989-1990	Detroit Pistons	Portland Trail Blazers	4-1
1990-1991	Chicago Bulls	Los Angeles Lakers	4-1
1991-1992	Chicago Bulls	Portland Trail Blazers	4-2
1992-1993	Chicago Bulls	Phoenix Suns	4-2
1993-1994	Houston Rockets	New York Knickerbockers	4-3
1994-1995	Houston Rockets	Orlando Magic	4-0
1995-1996	Chicago Bulls	Seattle SuperSonics	4-2
1996-1997	Chicago Bulls	Utah Jazz	4-2
1997-1998	Chicago Bulls	Utah Jazz	4-2
1999†	San Antonio Spurs	New York Knickerbockers	4-1
1999-2000	Los Angeles Lakers	Indiana Pacers	4-2
2000-2001	Los Angeles Lakers	Philadelphia 76ers	4-1
2001-2002	Los Angeles Lakers	New Jersey Nets	4-0

*Basketball Association of America champions.
†Shortened season began in 1999 due to player-management disagreement.

Focus on Sports

The Harlem Globetrotters, an all-black professional team, began playing in 1927. The team has entertained fans throughout the world with its blend of comedy and basketball skills.

Until about 1950, college basketball was a largely segregated sport. Gradually, black players were allowed to play on teams that previously had only white players. By the mid-1960's, many players on major college teams were black.

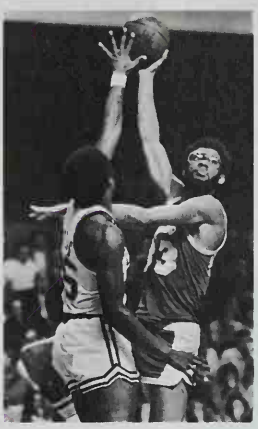
The University of California at Los Angeles (UCLA) dominated college basketball in the 1960's and 1970's. The UCLA teams, coached by John Wooden, won 10 NCAA basketball titles between 1964 and 1975.

The history of professional basketball. The first professional basketball league was the six-team National League, formed in 1898. It lasted for five seasons. The Buffalo Germans, founded in 1895, dominated early professional basketball. The team won 111 straight games from 1908 to 1910. The most famous professional team of the early 1900's was the Original Celtics of New York City, founded in 1918. The team won 720 of 795 games from 1921 to 1928.

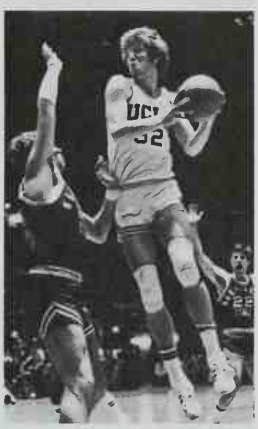
The American Basketball League was formed in 1925 with teams from the East and Midwest. The league dis-

AP/Wide World

AP/Wide World



Bruce Curtis



Norman Schindler, UCLA

Outstanding centers have ranked among the greatest stars in basketball history. Leading centers have included George Mikan, *with ball, far left;* Bill Russell, *left,* and Wilt Chamberlain, *second picture;* Kareem Abdul-Jabbar, *third picture;* and Bill Walton, *number 32, far right.*

AP/Wide World

Bruce Curtis

AP/Wide World

AP/Wide World

Great NBA scorers included Elgin Baylor, *in dark uniform, far left;* John Havlicek, *with ball, left;* Jerry West, *in dark uniform, third picture;* and Oscar Robertson, *with ball, far right.* All four also gained recognition for their all-around team play during their professional careers.

Focus on Sports

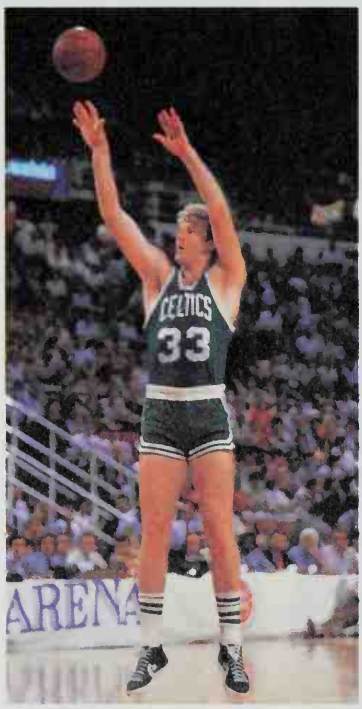
Julius Erving was an exciting professional player noted for his outstanding jumping ability and spectacular shots.

Focus on Sports

Isiah Thomas was a leading NBA guard famous for his ballhandling and his skill at shooting among taller players.

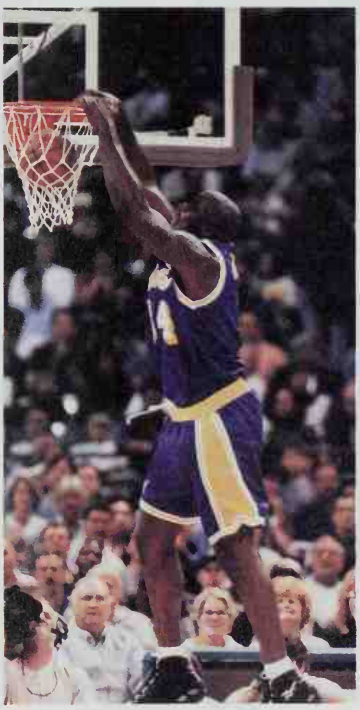
Focus on Sports

Magic Johnson became one of the best all-around guards in the NBA as a passer, shooter, and rebounder.



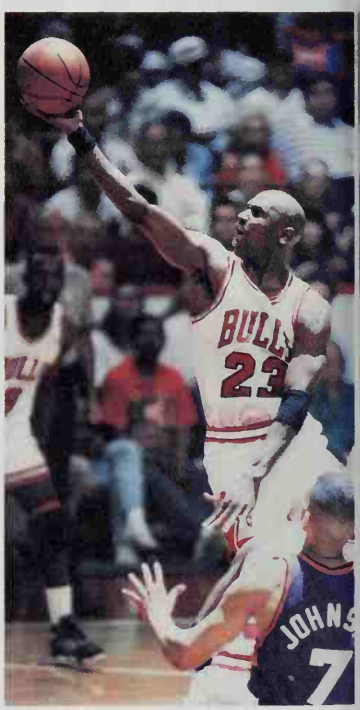
Focus on Spurts

Larry Bird was one of the top all-around players in the NBA. He excelled in shooting, passing, and rebounding.



Reuters/Archive Photos

Shaquille O'Neal has become celebrated in the NBA for his scoring and his powerful dunk shots.



Reuters/Archive Photos

Michael Jordan ranks among the most exciting players in the NBA with his brilliant shooting and thrilling dunk shots.

banded in 1931 and re-formed in 1933 with teams concentrated in the East. A primarily Midwestern league called the National Basketball League (NBL) was organized in 1937. The Basketball Association of America (BAA) was formed in 1946. The NBL and BAA merged in 1949 to form the National Basketball Association.

During the 1920's and 1930's, two all-black professional teams dominated their competition. The teams were the New York Renaissance Big Five, called the Rens, and the Harlem Globetrotters. Because professional leagues were segregated, the Rens and Globetrotters were forced to play exhibition games. The Globetrotters still play today.

In 1950, Chuck Cooper signed with the Boston Celtics, becoming the first black player in the NBA. In a short time, black players were on teams throughout the NBA. Some of the outstanding players of the 1950's and 1960's were such former black college stars as Bill Russell, Wilt Chamberlain, Oscar Robertson, and Elgin Baylor. Russell led the Boston Celtics to 11 NBA titles from 1957 to 1969.

In 1967, a professional league called the American Basketball Association was formed. It merged with the NBA in 1976, forming a 22-team league.

Basketball today. In 1968, the Naismith Memorial Basketball Hall of Fame opened on the campus of Springfield College. During the 1970's and 1980's, college basketball greatly increased in popularity. Much of this popularity came from the frequent regional and national televising of games. The NCAA Division I men's championship tournament now ranks among the major sports events of the year.

Professional basketball greatly increased its popularity starting in the 1980's. By the 1995-1996 season, the NBA had expanded to 29 teams, and teams played exhibition games overseas to increase the league's exposure in markets throughout the world. NBA players became eligible to play in the Olympic Games in 1992. A squad dominated by NBA stars won the championship at the 1992 Summer Games. The team, nicknamed the Dream Team, was undefeated and won every game by more than 30 points.

There has been an enormous increase in the popularity of women's basketball at both the high school level and the college level. Women's basketball became an Olympic sport in 1976. The NCAA held its first national tournament for women's teams in 1982.

John R. Thompson, Jr.

Related articles in *World Book* include:

Abdul-Jabbar, Kareem	Erving, Julius	Naismith, James
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Outline

I. How to play basketball
- A. The court
- B. Equipment
- C. The players
- D. The coach
- E. The officials
- F. Playing time
- G. Scoring
- H. Playing the game
- I. Offensive strategies
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- K. Fouls
- L. Violations

II. Basketball competition
- A. High school competition
- B. College competition
- C. Professional competition
- D. International competition

III. The history of basketball

Questions

How did Hank Luisetti and Joe Fulks contribute to basketball?
How many high schools sponsor girls' basketball teams?
What is meant by the *one-and-one?* The *penalty situation?*
How long is a high school game? A professional game?
How does the NCAA determine its annual champions?
Who invented basketball? When was the first game played?
What is a *technical foul?*
How long is a basketball court?
What are the duties of the scorekeepers?
What is a *man-to-man defense?* A *zone defense?*

Additional resources

Level I

Anderson, Dave. *The Story of Basketball.* Rev. ed. Morrow, 1997.
Lannin, Joanne. *A History of Basketball for Girls and Women.* LernerSports, 2000.
Miller, Faye Y. *Winning Basketball for Girls.* Rev. ed. Facts on File, 1992.
Vancil, Mark. *NBA Basketball Basics.* Sterling Pub., 1995.

Level II

Bjarkman, Peter C. *The Biographical History of Basketball.* Masters Pr., 1999.
Douchant, Michael, ed. *Encyclopedia of College Basketball.* Gale, 1995.
Hubbard, Jan, ed. *The Official NBA Basketball Encyclopedia.* 3rd ed. Doubleday, 2000.
Official NBA Guide. NBA Properties, published annually.
Thomas, Ron. *They Cleared the Lane: The NBA's Black Pioneers.* Univ. of Neb. Pr., 2002.
Wolff, Alexander. *Big Game, Small World.* Warner Bks., 2002

Basketry. See Basket making.

Baskin, Leonard (1922-2000), was an American printmaker and sculptor. His best-known works deal with the good and evil he saw in nature. In most of his prints and sculptures, Baskin portrayed a single man who symbolizes all humanity. This figure is often a victim of oppression. Baskin also included birds of prey, such as crows, eagles, and owls, in his works. These birds symbolize evil and death. Baskin designed a number of woodcuts, engravings, and drawings as book illustrations. He used bronze, limestone, or wood for his sculptures. Baskin created a granite bas-relief sculpture of President Franklin D. Roosevelt's funeral procession for the Franklin Delano Roosevelt Memorial in Washington, D.C., which opened in 1997. Baskin was born on Aug. 15, 1922, in New Brunswick, New Jersey. Elizabeth Broun

Basov, *BAH suhf,* **Nikolai Gennadievich,** *nee kaw LY geh neh DEE yuh vihch* (1922-2001), was a noted Russian physicist. In 1953, he and Russian physicist Alexander Prokhorov stated principles for using the energy of molecules to amplify microwaves. Basov and Prokhorov developed these amplifiers, which are called *masers,* during the next two years (see Maser). For their work, Basov and Prokhorov shared the 1964 Nobel Prize in physics

with the American physicist Charles H. Townes.

Basov was born on Dec. 14, 1922, in Petrograd (now St. Petersburg) and graduated from the Moscow Engineering and Physics Institute in 1950. In 1948, he became a laboratory assistant at the Lebedev Institute of Physics in Moscow. There, he held various positions, including the post of director from 1973 to 1989. Basov died on July 1, 2001. William B. Case

Basques, *basks,* are a group of people who live in the western Pyrenees Mountains on the border between France and Spain. About 2 $\frac{1}{2}$ million Basques live in Spain, and about 500,000 live in France.

The Basques have lived in the Pyrenees for over 5,000 years. They lived there long before such early peoples as the Gauls and Iberians settled near them. The Basque language, Euskara, is not related to any known language. Most experts believe it is the oldest living language in Europe. About 25 percent of Basques speak Euskara.

France and Spain have ruled the Basques for hundreds of years. In the 1800's, movements began to preserve the Basque language and culture and to gain independence from Spain. In 1937, General Francisco Franco, the dictator of Spain, crushed the movements and abolished most rights of the Spanish Basques, including the use of Euskara.

In the 1960's, many Spanish Basques renewed demands for a separate Basque government and culture. A group called *Euskadi ta Askatasuna* (ETA), which means *Basque Homeland and Freedom* in Euskara, began a campaign of violence. Spain's government fought back, killing or arresting many ETA members.

In 1980, the Spanish government granted the Basques limited self-rule, making three Basque provinces a self-governing region within Spain. However, ETA continued its terrorist campaign. Jacqueline Urla

See also Spain (picture: The Basques).

Basra. See Al Basrah.

Bass, *bas,* is a type of game fish known for its fighting ability when hooked. It is also a popular food fish. Many scientists recognize two chief groups of bass: (1) black bass and (2) true bass.

Black bass are members of the sunfish family. They live in lakes, rivers, and other bodies of fresh water. They are prized as food and sport fish and are protected from commercial use. There are six species of black bass: (1) largemouth, (2) smallmouth, (3) spotted, (4) redeye, (5) Guadalupe, and (6) Suwannee. All six species have a long, yellowish or greenish body with two connected fins on the top of the back. All except the smallmouth have a dark band along the side of the body.

Largemouth bass are found in lakes, ponds, and rivers throughout the United States and in Canada and Mexico. The tremendous strength of these fish makes them a favorite among fishing enthusiasts. Most adult largemouth weigh from 1 to 4 pounds (0.5 to 1.8 kilograms). Some grow to more than 20 pounds (9 kilograms). The longest

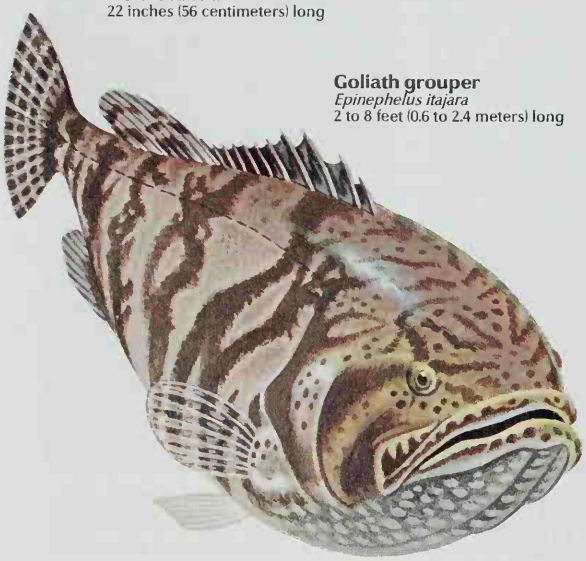
Some kinds of bass

WORLD BOOK illustrations by James Teason

Striped bass
Morone saxatilis
22 inches (56 centimeters) long

WORLD BOOK illustration by John F. Eggert

Largemouth bass
Micropterus salmoides
18 inches (46 centimeters) long



Goliath grouper
Epinephelus itajara
2 to 8 feet (0.6 to 2.4 meters) long

WORLD BOOK illustration by John F. Eggert

Smallmouth bass
Micropterus dolomieui
9 inches (23 centimeters) long

Spotted bass
Micropterus punctulatus
7 inches (18 centimeters) long

largemouth measure more than 2 feet (0.6 meter).

Smallmouth bass are especially strong fighters for their size. Most adult smallmouth bass weigh from $\frac{1}{2}$ to 4 pounds (0.2 to 1.8 kilograms). Smallmouth live in streams and large lakes throughout most of the United States and in parts of Canada, Europe, and South America.

Spotted bass, also known as *Kentucky bass,* live chiefly in southern regions of the United States. These fish are usually found in deep, clear reservoirs. They are generally smaller than smallmouth bass.

The other three species of black bass are found in parts of the southern United States. Redeye bass live in streams in the Southeast. Guadalupe bass inhabit streams in south-central Texas. Suwannee bass are found in rivers of northern Florida.

True bass can be divided into two categories: (1) temperate bass and (2) sea bass. Most species of true bass live in the ocean.

Temperate bass are silvery fish with two fins on the top of the back that are separated or only slightly connected. Most temperate bass have six or seven bold stripes along the side of the body.

There are seven species of temperate bass in North America. Four species—the *white bass, yellow bass, striped bass,* and *white perch*—can be found in bodies of fresh water. White bass and yellow bass are strictly freshwater fish. They live in rivers and lakes from the Gulf of Mexico to the Great Lakes. Striped bass and white perch are native to the Atlantic Ocean. But some striped bass and white perch now live only in freshwater areas because of the damming of inland waters in which they breed. Striped bass are common in Atlantic coastal regions and in the South. They are caught both commercially and for sport. Most adult striped bass weigh from 2 to 20 pounds (0.9 to 9 kilograms).

Sea bass total about 370 species. These fish have a single fin on the back and many have spots. The *goliath grouper* is one of the largest species of sea bass. It grows up to 8 feet (2.4 meters) long and may weigh as much as 700 pounds (320 kilograms). The goliath grouper inhabits the Gulf of Mexico, the Florida coast, and tropical areas of the Atlantic Ocean. Robert D. Hoyt

Scientific classification. Black bass belong to the sunfish family, Centrarchidae. True bass consist of certain members of two families—the temperate bass family, Percichthyidae, and the sea bass family, Serranidae.

See also **Fish** (pictures: Fish of coastal waters and the open ocean, Fish of temperate fresh waters); **Goliath grouper**.

Bass, *bays,* a stringed musical instrument, is the largest and lowest-pitched member of the violin family. It is also called the *bass viol, contrabass,* or *double bass.* A bass measures about 6 feet (1.8 meters) long. Most basses have four strings, with an optional mechanism for lengthening the bottom string to lower the pitch. The player's right hand plucks the strings or uses a bow. The left hand sets the pitch by pressing the strings against the fingerboard. Large symphony orchestras have 8 to 10 basses, and some chamber music groups include a bass. The bass is an important rhythm instrument in jazz and popular music. Abram Loft

See also **Jazz** (The bass).

Bass, Sam (1851-1878), was a Texas outlaw. Born in Indiana on July 21, 1851, he left home at 17 to find work as a cowboy and became involved with criminals. During his six years in Texas, he became known as a "good badman." He led a band of bank and train robbers and, according to legend, shared what he stole with the poor. Bass was betrayed to the Texas Rangers by one of his own men at Round Rock in 1878 and was killed on July 21, 1878. His legend has been kept alive by the ballad that bears his name and by stories of his generosity. Clifford L. Egan

Basse-Terre, *BAHS TAIR* (pop. 13,656), is the capital of the French overseas *department* (administrative district) of Guadeloupe in the Antilles. It lies on the southwestern coast of Basse-Terre Island (see **Guadeloupe** [map]). The city is an airline and steamship center. It exports bananas, cocoa, coffee, and sugar. The French began settling there in 1643. Gary Brana-Shute

Basset hound is a heavily built, low, long-bodied dog bred to hunt rabbit and other small game. Basset hounds are *scent hounds*—that is, dogs that hunt with their nose to the ground to follow an animal's scent. They have long ears that drag along the ground while hunting and stir up the scent of the prey. The origins of the dog can be traced to hounds bred in the 1600's by the abbots of St. Hubert in France.

Most bassets are black, white, and tan or red and white. A typical basset stands from 12 to 14 inches (30 to 36 centimeters) high and weighs from 45 to 60 pounds (20 to 27 kilograms). See also **Dog** (picture: Hounds).

Critically reviewed by the Basset Hound Club of America, Inc.

© Pamella McReynolds

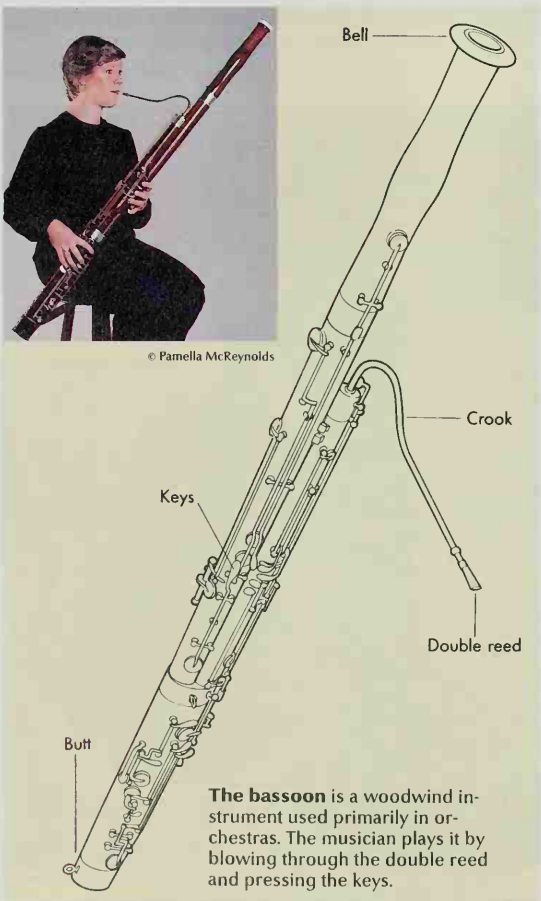
The bass is the largest stringed instrument played with a bow. A bass player may also pluck the strings with the fingers.

Bassett, Richard (1745-1815), a lawyer and statesman from Delaware, was a signer of the Constitution of the United States. He played a minor role at the Constitutional Convention of 1787, but he helped win *ratification* (approval) of the Constitution in Delaware.

Bassett was born in Cecil County, Md. About 1770, he began practicing law in Dover, Del. During the Revolutionary War in America (1775-1783), Bassett was a captain of a troop of cavalry. He was a member of the Annapolis Convention of 1786, which laid the groundwork for the Constitutional Convention of 1787. Bassett served as a United States senator from 1789 to 1793 and as chief justice of the Delaware Court of Common Pleas from 1793 to 1799. He was governor of Delaware from 1799 to 1801. He served as a judge of the U.S. Circuit Court in 1801 and 1802. Barbara E. Benson

Bassoon is an instrument that serves as the bass voice of the woodwind section of many orchestras and bands. The bassoon has a double reed attached to the end of a curved metal pipe called a *crook*. The other end of the crook is inserted in a wooden tube. The tube consists of four sections that would measure about 8 feet (2.4 meters) long if placed end to end.

A musician blows through the double reed and presses keys on the tube. The keys open and close *tone holes* to produce different notes and tones. The *contra bassoon* is twice as long as the bassoon and is pitched one octave lower.



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The bassoon is a woodwind instrument used primarily in orchestras. The musician plays it by blowing through the double reed and pressing the keys.

WORLD BOOK illustration by Oxford Illustrators Limited

The early history of the bassoon is obscure, but the instrument dates back to the 1300's. The bassoon as we know it today was developed in Paris during the 1600's.

André P. Larson

Basswood. See Linden.

Bast is the general name for strong fibers obtained from the stalk or stem of certain plants. The fibers are typically stiff, and tan or yellow in color. These properties tend to limit their use to such products as ropes, cords, twines, and carpet backing. However, some types of bast fibers are made into fabric for clothing. Plants grown for bast include flax, hemp, jute, and ramie.

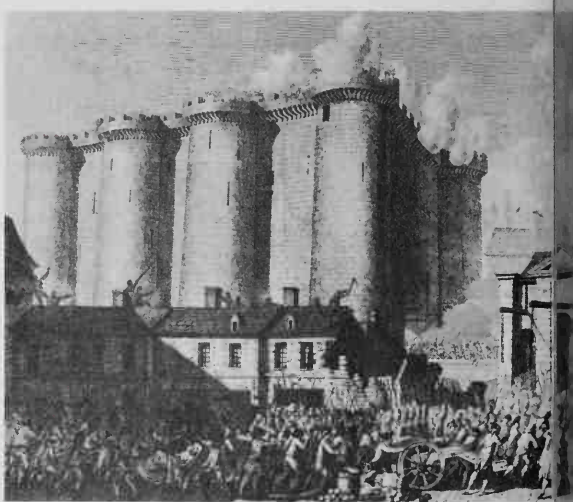
Robert A. Barnhardt

See also Fiber.

Bastille, *bas TEEL,* was a great fortress in Paris that stood as a symbol of royal tyranny. On July 14, 1789, at the beginning of the French Revolution, a large crowd of Parisians captured the Bastille. This act convinced King Louis XVI to withdraw his troops from Paris and to accept the French Revolution. Ever since then, the people of France have celebrated July 14 as their national holiday.

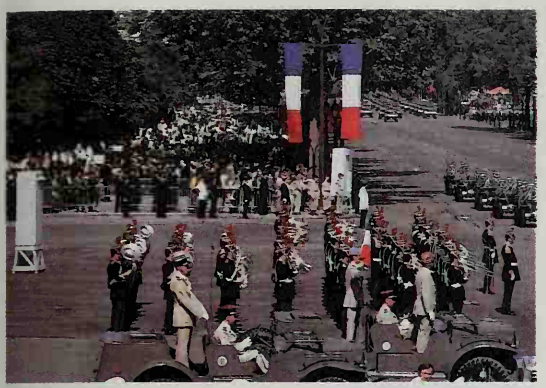
Bastille is a French word for a strongly fortified structure. About 1370, King Charles V built the Bastille of Paris as a fortress. Later, it was used as a prison for people who displeased the kings or their officials. By 1789, the Bastille held only a handful of prisoners. On July 14, the revolutionists surrounded the Bastille in order to seize gunpowder that was stored there. Troops fired on the menacing crowd. But the people stormed into the fortress, overpowered the troops, and killed the prison's governor. The following day, the people started to tear down the Bastille. Isser Woloch

Bastille Day, *bas TEEL,* is the great national holiday of France, corresponding to Independence Day. It is celebrated on July 14 because on that day in 1789 the people of Paris attacked and captured the Bastille (see **Bastille**).



The Storming of the Bastille, an engraving, 1798, by Pierre Gabriel Berthault; New York Public Library

The Bastille fell to the people of Paris on July 14, 1789. The next day, the people began to demolish the hated prison. They later gave the key to the prison to George Washington.



© Harvey Lloyd, The Stock Market

Bastille Day is France's most important national holiday. It commemorates a popular uprising against the government in 1789. A parade, *above,* is part of the annual celebration of the holiday.

The Bastille was an old fortress that had been used as a prison. Its capture symbolized the new spirit of freedom that swept through France and led to the establishment of a popular government. The celebration of Bastille Day is ordinarily cause for national rejoicing, with parades, music, and dancing in the streets. However, during the German occupation of France in World War II (1939-1945), the French stayed in their homes and did not celebrate Bastille Day. The storming of the Bastille has inspired a number of songs, pamphlets, and orations. Isser Woloch

Basutoland. See Lesotho.

Bat is the only mammal that can fly. Bats have a furry body, and their wings are covered by smooth, flexible skin. Most species of bats live in attics, caves, or other sheltered places. Some species live in trees. Bats seem uncommon in many regions because they roost in dark places and come out only at night, when most people are asleep. Bats hang upside down when they are resting.

There are more than 900 species of bats. Bats live in all parts of the world except Antarctica and the Arctic. Most kinds make their home in the tropics, where they can find food the year around. About 40 species of bats live in Canada and the United States.

Through the centuries, people have passed on many superstitions and mistaken ideas about bats. For example, the expression "blind as a bat" is false. All species of bats can see, probably about as well as human beings. The beliefs that bats carry bedbugs and get tangled in people's hair are also untrue. Bats tend to be timid. At night, they will try to fly out a window if they find themselves in a room.

Many people in Western countries fear bats, but these animals are well liked in China and Japan. A number of Oriental artists have portrayed bats as signs of good luck, happiness, and long life.

Most bats are harmless to people. But bats may have rabies. For this reason, bats should not be handled.

Bats perform a valuable service for people by eating large numbers of insects. In addition, bat *guano* (manure) has commercial value as fertilizer. Some caves have been the home of bats since prehistoric times and have large deposits of guano.

The body of a bat

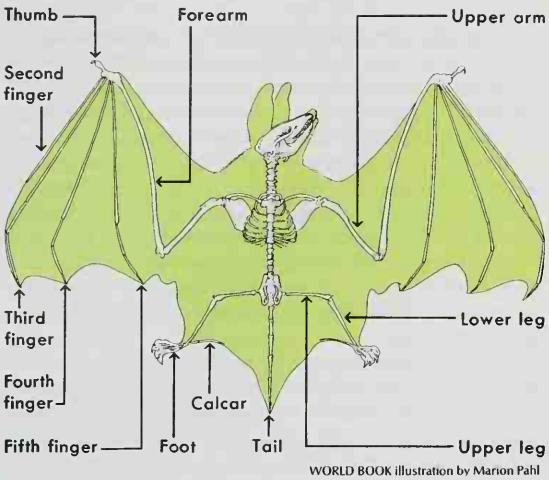
Bats vary in appearance and size, depending on the species. Bats that live in the open may have bright colors and markings. Those that live in dark, sheltered areas have black, brown, gray, red, or yellow fur.

The largest bats, called flying foxes, have a wingspan of more than 5 feet (1.5 meters) and a body about the size of a pigeon's. The Kitti's hog-nosed bat of Thailand, the smallest species, is about the size of a bumble bee

S. C. Bisserot, Bruce Coleman Ltd.

The sight of a flying bat frightens many people unnecessarily. Bats do little harm to people or to crops and livestock. These expert fliers even help people by catching and eating large numbers of destructive insects.

The skeleton of a bat



WORLD BOOK illustration by Marion Pahl

and weighs only about $\frac{1}{14}$ ounce (2 grams). It is one of the smallest known mammals in the world. Many common North American bats have a wingspan of about 12 inches (30 centimeters) and weigh from $\frac{1}{6}$ to $\frac{2}{3}$ ounce (5 to 19 grams).

The skeleton of a bat resembles that of other mammals. Like many other mammals, a bat has hands with fingers and feet with toes. A bat's breathing rate, heartbeat, and body temperature, unlike those of many other mammals, vary greatly, depending on its activities and the temperature of its surroundings. Among some species, the temperature of a resting bat becomes the same as that of its environment.

Head. The face and head of bats vary greatly among the various species. Some bats have a head shaped like that of a miniature bear or dog. Other bats have a flatter face. Some species have folds of skin called a *nose-leaf* on their snout. The nose-leaf may look like a spearhead or a blade. Bats have a good sense of smell that helps them find food and their roost.

Most bats have small, sharp teeth that reduce food to a soupy texture. Bats digest their food more quickly than many other mammals. This rapid digestion helps them avoid having extra weight while flying.

Wings and legs. A bat's hands serve as its wings. Its long fingers support the flexible skin of the wings. The upper arm, forearm, and second and third fingers make up the front edge of the wing. The fourth and fifth fingers help support the wing. The inner edge of the wing extends down the side of the body and along the leg to the ankle and foot.

The length of a bat's wings varies from species to species. The swiftest species of bats have long, narrow wings. Some species, which can hover in one place, have short, broad wings. Some bats can fly as fast as 15 miles (24 kilometers) per hour, but most of them travel from 5 to 8 miles (8 to 13 kilometers) per hour.

Bats have weak legs. Many species have a tail and a membrane between their legs. Some fold up their wings and use their arms and legs to walk. But a number of species do not walk at all. They use their legs simply to hang from their roost. Each foot has five toes with semicircular pointed claws that enable the animal to hang securely from twigs and rocks.

The life of a bat

Many species of bats live in colonies that may have thousands or even millions of members. Others live alone or in small groups. Most bats spend the day sleeping in their roost. They also may groom their fur and wings or tend their young during the day.

About an hour before dusk, bats start to move around or take short flights. At dusk, they begin to fly from their roost and head for their feeding grounds. Many species eat insects, and each species seeks its own kind of feeding area. Some bats feed in open areas. Other kinds feed in heavy jungles or above a pond.

Many bats eat as much as half their weight in food each night. They then rest in either their daytime roost or a different night roost. After digesting their meal, they may eat again. Sometime before dawn, they return to their daytime roost in order to sleep.

Bats have few enemies. Such animals as cats, hawks, owls, snakes, and weasels sometimes prey on bats. Bats avoid many enemies on the ground by hanging from high places. Some species of bats live as long as 15 to 25 years.

How bats navigate. Some bats depend on their vision and sense of smell to navigate and to find food at night. Other bats cannot see well in the dark. They navigate by means of echoes. These echoes result from a series of short, high-frequency sounds that the bats make continually while flying. From these echoes, the animals can determine the direction and distance of objects in the area. This process of navigating is referred to as *echolocation*. Each species of bat that uses echolocation makes its own kind of noises. Most of these sounds extend beyond the range of human hearing. Some zoologists believe that a bat may use its lips or nose-leaf to direct the sounds in a particular direction or at a specific target, such as an insect. Echoes from the insect give the

Nina Leen, *Life* © Time Inc.

Long-nosed bats, *above,* feed on nectar from the flowers of a cactus. They use their long tongue to lap up the nectar. Long-nosed bats live in Mexico and the Southwestern United States.

bat information about the movement of the prey, in addition to its direction and distance.

Food. Many species of bats feed on insects that fly at night. A bat catches insects in its mouth, tail membrane, or wings as it flies.

Numerous species of bats prey on large insects, scorpions, or spiders on the ground. Other bats pluck insects from the surface of water with their mouth or claws. Some bats catch fish with their claws, and a few species eat lizards, rodents, small birds, tree frogs, and other bats. The vampire bat feeds on the blood of other animals.

Several kinds of tropical bats feed on plants. Some of these species gather nectar and pollen from flowers. Such bats pollinate the plants on which they feed. Other tropical bats eat fruit and thus help spread the seeds of many plants. These bats may drop small seeds from their mouth as they eat at their feeding ground. They also may bring fruit with large seeds to their roost and drop the seeds there after eating the fruit. Seeds also are deposited with the bats' guano. The seeds may land on soil and sprout.

Bats that eat moist foods do not need to drink much water. Many species of bats lap up water with their tongue as they fly near the surface of a pond or stream.

Hibernation and migration. Many bats hibernate or migrate during the winter because of low temperatures and a poor food supply. Insects and plant foods become scarce in winter. Most North American bats hibernate in caves or rocky places. While hibernating, they live off the extra fat that they gain during the late summer.

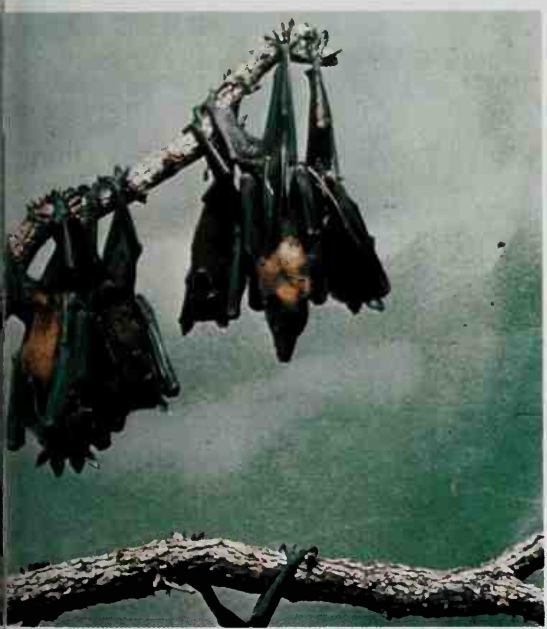
Some North American bats migrate in the fall to find food or a better place to hibernate. They may fly long distances to find a suitable shelter that will protect them from the harsh winter weather. Most cave bats spend each winter in the same place, and each summer in the same roost.

Bats of the tropics do not hibernate. The temperature and food supply there remain suitable all year. Scientists know little about the migration of tropical bats.

Reproduction. Among many species of bats, the males and females occupy different roosts. The males and females of some species even live in different regions of a continent except during the mating season. The mating season, which lasts for only a few weeks, may occur during the spring, fall, or winter, depending on the species. The female may carry the male's sperm within her body for several months before she becomes pregnant. In the spring, pregnant bats may leave their usual colony and join together in a *nursery colony,* where they give birth and rear their young.

The females of most species of bats have one baby a year. Some bats have a baby twice a year. A few species have up to four young at a time.

A newborn bat weighs about a fifth as much as an adult bat. Bats do not build nests, and so the infant must hold on to its mother or its home roost. Among some species, the infant clings to the mother for several weeks. The infants of other species stay in their roost, where they hang from a rock alone or with a group. Female bats nurse their young for six to eight weeks.



Nina Leen, *Life* © Time Inc.

Roosting bats hang upside down. Most bats spend the daylight hours resting in this position. Flying foxes, *above,* usually roost in trees. Many kinds of bats roost in caves and in buildings.

Some kinds of bats

Flying foxes and vampire bats are well known because of their unusual diet. Flying foxes eat mostly fruit, and vampire bats feed on the blood of other animals. Both live in tropical regions, where their feeding habits may damage the local economy. The most common bats in North America include brown bats, free-tailed bats, the hoary bat, the red bat, and the silver-haired bat.

Flying foxes and similar species known as *fruit bats* live in most tropical regions of Africa and Asia. These bats eat mostly fruit and occasionally damage orchards. Flying foxes also eat flower buds, nectar, and pollen. Flying foxes have large eyes and better vision than many other bats.

Vampire bats include a few kinds of bats that feed on the blood of other animals. The *common vampire bat* lives in Central and South America. It weighs about 1 ounce (28 grams) and has a wingspan of about 12 inches (30 centimeters). It preys mainly on cattle. It sometimes bites human beings, but such incidents are rare. Vampire bats approach their prey on foot. They scoop out a small piece of the victim's skin with their sharp teeth and then lick blood from the wound. Vampire bats consume about 1 tablespoon (15 milliliters) of blood a day. The wound they give their victims heals quickly, but these bats may carry rabies.

Brown bats include the big brown bat and the little brown bat, both of which live in the United States. Brown bats live in buildings or caves, and some migrate before they hibernate in winter. The big brown bat has dark brown fur and a wingspan of about 12 inches (30 centimeters). The little brown bat has dark brown fur and black forearms and ears. Its wingspan measures about 8 inches (20 centimeters).

Free-tailed bats are a group of dark brown bats that live throughout the world. Their tail extends beyond the

tail membrane. A few kinds of free-tailed bats, especially the Mexican free-tailed bat, can be found in the southern United States. The Mexican free-tailed bat has large ears, sharp teeth, and a wingspan of up to 12 inches (30 centimeters). Mexican free-tailed bats live in colonies, mostly in caves.

The hoary bat, the largest bat of North America, has a wingspan of about 16 inches (41 centimeters). White hairs cover its reddish-brown underfur, giving the bat a spotted appearance. Hoary bats live alone in trees and migrate south for the winter.

The red bat has white-tipped red fur. The male is bright red, and the female is grayish-red. Red bats have short, rounded ears covered with fur. Their wingspan measures about 12 inches (30 centimeters). They live alone in trees and fly south every winter.

The silver-haired bat has dark underfur with white outer hair. Both males and females have brownish underfur, but the male has blacker coloring. The silver-haired bat has a wingspan of about 13 inches (33 centimeters). It lives in trees. In summer, the males live alone, and the females in groups. Some silver-haired bats hibernate in winter, but most migrate south.

Clyde Jones

Scientific classification. Bats make up the order Chiroptera in the class Mammalia and the phylum Chordata. To learn where this order fits into the animal kingdom, see **Animal** (table: A classification of the animal kingdom). Flying foxes and their relatives make up the suborder Megachiroptera; all other bats belong to the suborder Microchiroptera.

See also Animal (picture: Animals of the deserts); **Flying fox; Vampire bat.**

Additional resources

Nowak, Ronald M. *Walker's Bats of the World.* Johns Hopkins, 1994.

Ruff, Sue, and Wilson, D. E. *Bats.* Benchmark Bks., 2001. Younger readers.

Tuttle, Merlin D. *America's Neighborhood Bats.* Rev. ed. Univ. of Tex. Pr., 1997.

Wilson, Don E. *Bats in Question.* Smithsonian Institution, 1997.

Bat mitzvah, *baht mihts VAH,* is a religious observance in Judaism that celebrates a girl's entry into the adult Jewish community. The term means *daughter of the commandments.*

When a girl reaches physical maturity, assumed to be the age of 12, she is responsible for all the religious observances, obligations, and prohibitions of a Jewish adult. No formal religious ceremony is needed for this to happen, but many families gather with their friends to celebrate the occasion. In most cases, the girl prepares for many weeks for the bat mitzvah service because it usually includes a public demonstration of what she has learned about Judaism.

B. Barry Levy

See also **Bar mitzvah; Judaism** (Special occasions).

Bataan Death March. See World War II (Early Japanese victories).

Bataan Peninsula juts into Manila Bay from the southwestern coast of Luzon, largest of the Philippine Islands. On Bataan Peninsula, United States and Filipino troops held out for just over three months against advancing Japanese forces during World War II. Late in December 1941, General Douglas MacArthur managed to withdraw his scattered troops into this hilly country. Once established on the peninsula, United States and Filipino forces found themselves hemmed in by the Japanese and cut off from any help.

WORLD BOOK maps

Bataan Peninsula is part of Luzon, the largest island of the Philippines. Here U.S. and Filipino troops held out for over three months in World War II.

For just over three months, this band of defenders beat back Japanese attacks. When the Japanese forces broke through their lines, the Americans and Filipinos withdrew to the very tip of Bataan Peninsula. MacArthur was ordered to report to Australia, and Lieutenant General Jonathan M. Wainwright took command of United States and Filipino forces in the Philippines. Major General Edward P. King, Jr., took command of United States and Filipino forces on Bataan Peninsula. On April 9, 1942, General King surrendered to the Japanese. The Japanese took about 75,000 Americans and Filipinos prisoner.

Some of the soldiers escaped to the fortress of Corregidor, in Manila Bay. At Corregidor, the defenders held out against the Japanese forces until May 6, 1942.

In February 1945, troops under the command of General MacArthur returned to Bataan. They landed on southern Bataan, captured points on Corregidor, and opened Manila Bay. The Japanese forces surrendered, and surviving Americans and Filipinos were freed. In 1954, President Ramón R. Magsaysay of the Philippine Republic issued an order making the battlefield areas of Bataan and Corregidor national shrines.

David J. Steinberg

Bates, Henry Walter (1825-1892), was a British naturalist who became known for his studies on *mimicry* in insect behavior. Mimicry is the ability of a species to resemble other species or its surroundings. One type of mimicry, *Batesian mimicry,* was named after Bates. Batesian mimicry occurs when a harmless species (the *mimic*) looks like a species (the *model*) that is dangerous or annoying to its predators. The mimic species is protected from its predators only by its visual resemblance to the model species.

Bates was born on Feb. 8, 1825, in Leicester, England. He spent 11 years in South America and collected about 14,000 insect specimens. Over half of these specimens were new discoveries. He first traveled to Brazil in 1848 with his friend Alfred Russel Wallace, who was also a noted naturalist. Bates described his exploration of the Amazon Basin in his book *The Naturalist on the River Amazons* (1863). Bates's studies of insect behavior and adaptation supported the theory of evolution proposed

by Wallace and also by Charles Darwin. According to this theory, animals *evolve* through *natural selection,* a process by which those individuals that are best suited to their environment are more likely to survive.

G. J. Kenagy

Bates, Katharine Lee (1859-1929), an American poet and educator, wrote the words to the popular patriotic song "America the Beautiful." She originally composed the words as a poem in 1893. The poem, inspired by a spectacular view she had seen from Pikes Peak in Colorado, first appeared in 1895 in *The Congregationalist,* a religious magazine. Many people wanted the poem set to music, and the melody "Materna" (1882), by the American composer Samuel Augustus Ward, was chosen.

Bates was born in Falmouth, Mass. She graduated from Wellesley College and taught English literature there from 1885 to 1925. When Bates was made a full professor in 1891, she was among the few women in the United States to hold that rank. Bates wrote a number of scholarly books. Her most famous books include *The English Religious Drama* (1893) and *American Literature* (1897).

Samuel Chase Coale

Bath is a health resort city in England. It has warm springs and mineral waters. Some people believe the springs and waters have health-giving qualities. Bath is the chief city in the district of Bath, which has a population of 84,300. Bath lies on the River Avon, near Bristol in southwestern England (see **England** [political map]). It is surrounded by hills. This sheltered position gives the city a mild climate. Bath is famous for the Georgian architectural style of its houses. The Abbey Church of St. Peter and St. Paul in Bath dates from 1499. The Romans founded Bath and used the springs. Baths that the Romans built still stand. Bath became a resort for English high society in the 1700's. The *Wife of Bath* is a famous character in English poet Geoffrey Chaucer's *Canterbury Tales.*

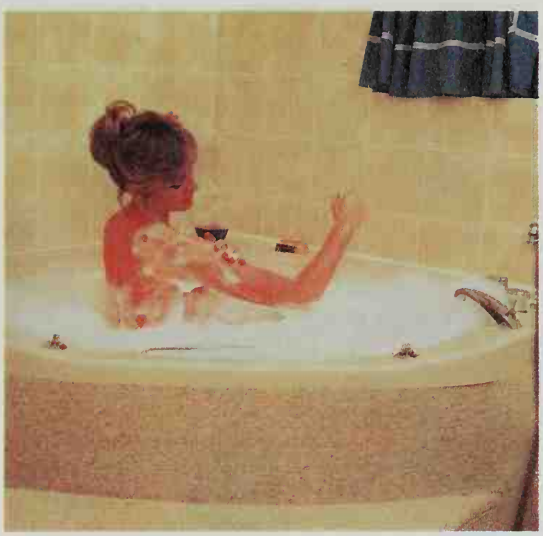
Peter R. Mounfield

Bath is the act of washing the body. Bathing cleans and deodorizes the skin. The main types of bathing are (1) bathing for cleanliness, (2) medical bathing, (3) bathing for relaxation or pleasure, and (4) religious bathing.

Bathing for cleanliness. The most common method of bathing is to wash with soap and water. Bathers may sit in a tub that contains water or stand under a shower and allow water to pour over their bodies. Soap helps remove bacteria, dead skin, dirt, lint, and body oil. The soap forms a thin layer around particles of dirt and suspends the particles in water until they are rinsed away.

Steam baths, also called *Turkish baths* or *Russian baths,* are used in many parts of the world. To take a steam bath, bathers sit in a steam-filled room until they sweat freely. Sweating cleans the pores of the skin. The bathers rinse in cold water to wash away perspiration and close the pores.

The *sauna* is a type of bath involving dry heat. A traditional sauna consists of a room or bathhouse with wood-paneled walls, a stove on which stones are heated, and wooden benches. Bathers sit or lie on the benches in the sauna and occasionally throw water on the hot stones to produce steam. The sauna remains dry, however, because the wooden walls absorb moisture. The temperature in a sauna ranges from 176 to 212 °F (80 to 100 °C). Bathers may beat themselves or one another gently with birch whisks to loosen dead skin and stimulate circulation. They rinse off in cold water.



Shostal

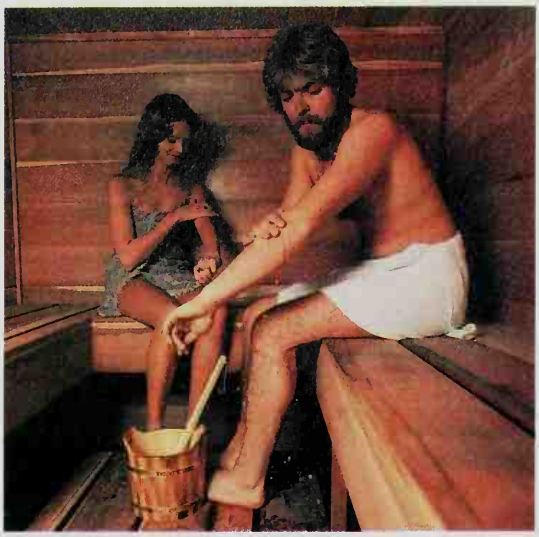
A modern bathtub has built-in faucets and surfaces made of enameled porcelain. Enameled bathtubs began to be produced in large numbers in the United States and Europe about 1920.

The *bidet,* a common bathroom fixture in many European countries, is used to bathe the genitals. The bather sits on the bidet and washes as water sprays upward from the bowl.

Medical bathing. Bathing has many uses in the treatment of disease. Bathing in hot water that ranges from about 98 to 112 °F (37 to 44 °C) relaxes muscles, enlarges blood vessels near the surface of the skin, and improves circulation. Warm baths that range from about 90 to 97 °F (32 to 36 °C) may relieve sleeplessness and ease tension. Cold baths of less than 75 °F (24 °C) can reduce swelling. Whirlpools and water massages are used to treat arthritis, polio, rheumatism, and bone and muscle injuries.

For hundreds of years, people have visited health resorts called *spas* for medical baths. Most spas are on the site of a natural spring that yields bubbling, heated, or mineral-filled water. During the 1700's and 1800's, many physicians sent patients to spas to bathe or to drink the water, which was believed to have medicinal qualities. Spas were also popular vacation spots. Today, most people go to spas for a healthful vacation. Many spas offer massages, saunas, steam baths, mud baths, and exercise and diet programs. Famous European spas include Vichy, France; Baden-Baden, Germany; and Karlovy Vary (formerly Carlsbad), the Czech Republic. Popular spas in the United States include White Sulphur Springs, W. Va.; Saratoga Springs, N. Y.; Calistoga, Calif.; and Hot Springs, Ark., now a national park.

Bathing for relaxation or pleasure is popular in many countries. In Japan, people wash before soaking in a tub of hot water because the tub is used only for relaxation. During the 1970's, *hot tubs* became popular in the United States. They are large wooden tubs in which two or more people soak in steaming-hot water. Most hot tubs are outdoors. A 6-foot (1.8-meter) tub can hold up to 13 people. Most hot tubs have a heater, filter, and



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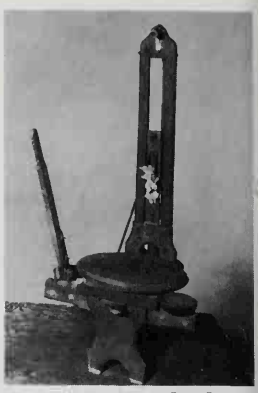
A sauna is a type of steam bath that has a stove on which stones are heated. Bathers may throw water on the stones or apply water to their skin, *above,* to add moisture to the air.

Crane Company



Crane Company

Bathing devices of the 1800's included a metal bathtub, *left,* and a hand shower, *right.* A lever on the shower pumped water on the bather from above and moved a back-washing brush.

pump. The pump in the hot tub circulates the water.

People also relax by bathing in mud. Spas in Calistoga, Calif., specialize in mud baths. The mud is composed of mineral water and soil containing volcanic ash. The bather reclines in a tub of mud about 100 to 104 °F (38 to 40 °C) for 12 to 15 minutes, followed by a 10- to 15-minute mineral water bath.

Religious bathing. Many religions call for bathing before or during religious observances. The ancient Israelites probably began the custom of religious cleansing. They believed it was important to wash themselves after contact with the dead or the insane, who were thought to be unclean.

The Hindus consider the Ganges River sacred and come to bathe in its waters to purify themselves. The sick come hoping the water will cure them.

Christians celebrate a person's entrance into the Christian faith with a ceremony called *baptism.* A person being baptized is dipped into water or sprinkled with it as a sign of washing away sin.

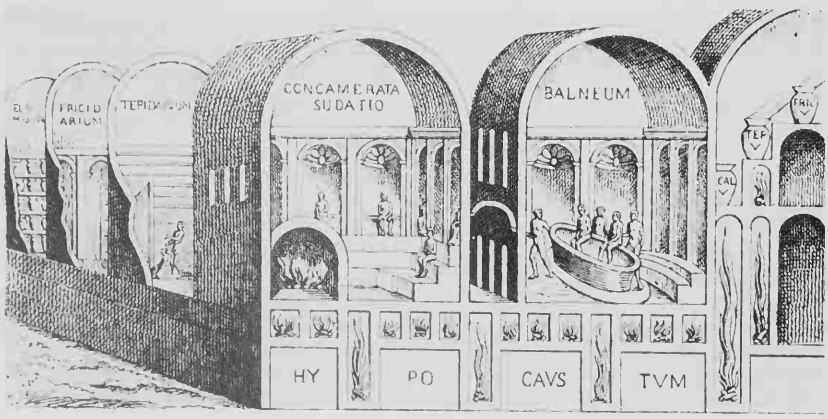
History. Archaeologists have found the remains of baths in the ruins of many ancient civilizations, including those of Babylon and Egypt. The ruins of public baths believed to be about 4,500 years old were discovered at Mohenjo-Daro (also spelled Moen jo Daro), near Larkana, Pakistan (see **Indus Valley civilization** [picture]).

In ancient Rome, only the wealthy could afford private bathrooms. But the Romans built public baths in nearly every city of the empire. The bathhouses had facilities for warm and cold baths, steam baths, and massages. By the 20's B.C., they had become social gathering places with marble floors and columns, painted ceilings, statues, gardens, gymnasiums, libraries, meeting halls, and theaters. The Baths of Caracalla in Rome, built in the early A.D. 200's, could hold 1,600 bathers at a time.

During the Middle Ages in Europe, bathing declined in popularity. Public bathhouses were called *stews,* and bathing was called *stewing* because bathers sat in hot water. By the 1400's, public baths had become centers for *prostitution,* the performance of sexual acts for payment. The word *stew* came to mean a house of prostitution. As a result, church and government officials passed laws forbidding public bathing. People seldom bathed at home either. They used paint and powder to hide dirt, and perfume to mask body odor.

The Puritans, a group of English Protestants who

Historical Pictures Service



Public bathhouses were common in ancient Rome because only the wealthy could afford private bathrooms. A typical public bathhouse in the Roman Empire, *left,* had various rooms for warm and cold baths, steam baths, and massages. The Baths of Caracalla in Rome, built in the early A.D. 200's, could hold as many as 1,600 bathers.

founded the New England Colonies, disapproved of bathing. They believed that nakedness, even to take a bath, led to sinful behavior.

However, bathing gained popularity in the United States during the late 1700's and early 1800's. The American statesman Benjamin Franklin brought a tub called a *slipper bath* from Europe to the United States. This tub was shaped like a slipper and hid the bather's body from view.

During the 1800's, most American homes did not have running water or bathrooms. Many families kept a bathtub in the bedroom and filled it by hand. People also began using hand-powered showers. The bather sat on a stool and worked a hand lever or foot pedal that pumped water on the head.

In 1855, the American millionaire George Vanderbilt acquired what was probably the first modern bathroom. But home bathing facilities remained a luxury until the 1900's. Modern bathtubs, with built-in faucets and protective surfaces of enameled porcelain, began to be mass-produced about 1920. Today, most U.S. homes have bathroom facilities, including a bathtub, shower, and sink. Gregory Frazier

Related articles in *World Book* include:
Baby (Bathing the baby)
Detergent and soap
Hot springs
Hungary (picture: Hungary's medicinal baths)
Hydrotherapy
Mineral water
Rome (Baths)
Sauna
Turkish bath

Bath, Knights of the. See Bath, Order of the.

Bath, Order of the, is the third highest and one of the oldest orders of knighthood in the United Kingdom. Only the Order of the Garter and the Order of the Thistle are higher. The Order of the Bath was founded by King George I in 1725. It originally consisted of the sovereign, a great master, officers, and 36 *knights companion.* Its name comes from the traditional ceremonial bath, a symbol of purity.

The British ruler confers the Order of the Bath chiefly on people who have performed outstanding government or military service. The order may also be conferred on leaders of foreign states.

The Order of the Bath includes three classes. These classes are the Knights and Dames Grand Cross of the Bath (G.C.B.); the Knights and Dames Commander (K./D.C.B.); and the Companions (C.B.). Members of the first two classes who are British subjects use "Sir" or "Dame" before their names.

Critically reviewed by the Order of the Bath

See also **Knighthood, Orders of** (pictures).

Bathsheba, *bath SHEE buh* or *BATH shuh buh,* was the beautiful wife of David, king of Israel. She was the mother of Solomon, who succeeded David. David married Bathsheba after arranging for her husband, Uriah the Hittite, to be killed in battle (see **David** [King of Israel]). J. Maxwell Miller

Bathurst. See Banjul.

Bathyscaph, *BATH uh skaf,* is a diving craft used for deep-sea observation. It can dive more than 6 miles (10 kilometers) to explore the deepest parts of the ocean. The bathyscaph consists of a thick-walled steel sphere attached to a large hull. The sphere protects the crew and scientific equipment from crushing water pressure. The hull contains several compartments filled with gasoline. The gasoline is lighter than water and gives the craft buoyancy.

The sphere is heavier than water, and the hull is lighter than water. To make the bathyscaph go down, the diver releases some of the gasoline or lets some seawater flow into the hull. The weight of the sphere then pulls the bathyscaph downward. To come up, the diver lightens the bathyscaph by releasing ballast from special sections in the hull. The bathyscaph has small screw propellers, which are turned by battery-driven motors, to move the bathyscaph horizontally.

The bathyscaph was designed by the French physicist Auguste Piccard. It was first tested in 1948. Today, other types of *submersibles* (deep-diving craft) now perform the tasks once done by bathyscaphs. Norman Polmar

See also **Diving, Underwater** (Submersibles); **Piccard** (Auguste).

Batik, *buh TEEK* or *BAT ihk,* is a method of applying colored designs to fabric. The word and the method come from Indonesia. A design is made on the fabric, and those sections that are not to be dyed are covered with a substance that will not absorb the dye. Liquid wax, paraffin, and rice paste are substances that are frequently used for this purpose. When the fabric is dipped into the dye, the covered parts resist the dye. After the cloth is dry, the wax can be removed by boiling the cloth.

Designs in two shades of one color can be made by covering dyed parts that are not to be deepened and dipping the cloth into the dye again. The process can be repeated as often as necessary to obtain new shades or to apply different colors. The pattern on the back of the cloth is less distinct than that on the front.

Many batik designs show thin, irregular lines. This effect results when the wax chips or breaks, and dye penetrates the breaks. In Indonesia, the design is frequently determined by the use the cloth will have. It might be for a headscarf, a sash, a sarong, or a loincloth.

Patrick H. Ela

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Batik is a method of decorating fabric with dye. The woman shown here is applying a wax coating to designs drawn on a piece of cloth. Next, the cloth will be dipped into dye. The wax-coated designs will resist the dye. After the wax is removed, the designs will stand out against the colored background.

Batista y Zaldívar, *bah TEES tah ee sahl DEE vahr,* **Fulgencio,** *fool HEHN syoh* (1901-1973), served as president of Cuba from 1940 to 1944. He ruled again from 1952 until 1959, when Fidel Castro ousted him in a revolt. In 1933, as an army sergeant, Batista led a revolt that overthrew the government. He rose to the rank of colonel and became Cuba's dominant military leader. Until 1940, he ruled through presidents who served in name only. In 1948, Batista was elected senator. He led a revolt against President Carlos Prío Socarrás in 1952. Batista was born in Banes, Cuba. Louis A. Pérez, Jr.

See also Cuba (History; picture).

Baton Rouge, *BAT uhn ROOZH* (pop. 227,818; met. area pop. 602,894), is the capital of Louisiana and a chief port of the United States. The city also ranks as a major Southern center of the chemical and petroleum industries. Baton Rouge lies on bluffs on the east bank of the Mississippi River, about 80 miles (130 kilometers) northwest of New Orleans. For the location of Baton Rouge, see Louisiana (political map).

French soldiers established Baton Rouge in 1719 as a military post to protect white travelers from attack by Indians. *Baton Rouge,* which means *red stick* in French, originally referred to a red-stained pole located on the site. The pole separated the territory of two Indian nations.

Baton Rouge has been ruled by seven governments. Britain, France, and Spain governed Baton Rouge during the 1700's. Then the Republic of West Florida, the United States, the Republic of Louisiana, the Confederate States of America, and again the United States ruled Baton Rouge.

Description. Baton Rouge, the *parish* (county) seat of East Baton Rouge Parish, covers about 73 square miles (189 square kilometers). The metropolitan area covers 1,587 square miles (4,109 square kilometers).

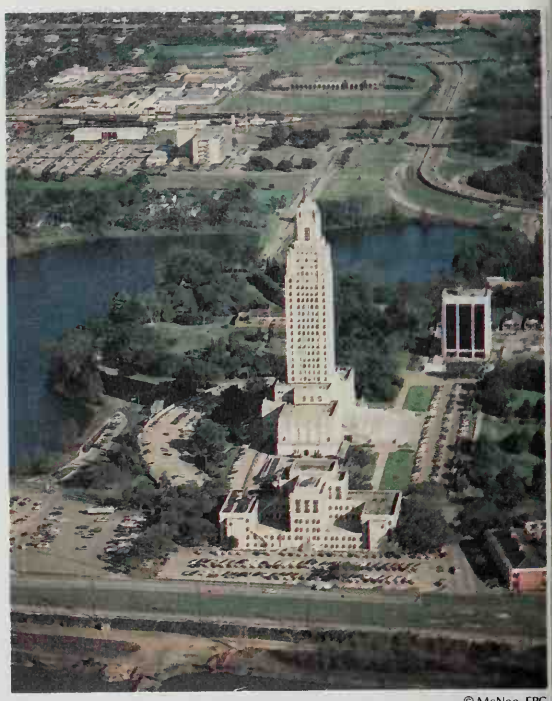
The 34-story State Capitol, Baton Rouge's tallest building, stands on the north edge of the downtown area. Senator Huey P. Long, a former governor and one of the most powerful figures in Louisiana history, was assassinated in the Capitol in 1935. He is buried on the Capitol grounds.

Cultural attractions in Baton Rouge include a symphony orchestra, art galleries, museums, a planetarium, a theater group, and a nearby zoo. The main campuses of Louisiana State University and Southern University are located in the city.

Baton Rouge has about 150 manufacturing plants. The manufacture of *petrochemicals* (chemicals made from petroleum and natural gas) ranks as the city's leading industry. One of the largest petroleum refineries in North America, operated by Exxon Mobil Corporation, is in Baton Rouge.

Other products made in Baton Rouge include fabricated metals, food products, lumber and wood products, printed materials, and synthetic rubber. State government offices provide another important source of employment.

Baton Rouge, located about 230 miles (370 kilometers) from the mouth of the Mississippi River, is one of the busiest inland ports in the world. The city handles large amounts of freight annually for river and ocean shipment. In addition, Baton Rouge is a distribution and transportation center for farm products.



© McNee, FPG

Baton Rouge, the capital of Louisiana, is an important United States port. The 450-foot (137-meter) high State Capitol stands on the north edge of the downtown area. It was completed in 1932.

Government and history. Baton Rouge and East Baton Rouge Parish have a joint mayor-council form of government. The voters elect a mayor and 12 council members, all to four-year terms. The city receives most of its income from sales taxes.

Bayou Goula and Houma Indians lived in what is now the Baton Rouge area when Europeans first arrived there. French soldiers founded Baton Rouge in 1719. In 1817, when Baton Rouge was incorporated as a town, it had a population of about 2,000.

Baton Rouge replaced New Orleans as the capital of Louisiana in 1849. In 1862, during the American Civil War, state leaders moved the capital to Opelousas after Union forces invaded Louisiana. That same year, a Union naval squadron under Captain David G. Farragut captured Baton Rouge. The city remained under federal control until 1877 and became the capital again in 1882. Commerce and trade gradually resumed during the late 1800's, and Baton Rouge began a period of new growth. By 1900, 11,269 people lived there.

During the early 1900's, the discovery of oil and natural gas in areas around Baton Rouge attracted chemical companies to the city. Baton Rouge became an important center of the petrochemical industry during World War II (1939-1945). Jobs created by additional industrial expansion helped the city's population more than triple during the 1940's. The population rose from 34,719 in 1940 to 125,629 in 1950. Baton Rouge continued to grow as an industrial center throughout the 1950's and 1960's. The oil boom of the 1970's spurred the local economy. The city's population grew by nearly 30 percent from 1970 to 1980.

In 1979, Baton Rouge completed a $100-million construction program. This program included an arena and exhibition building, a theater for the performing arts, and a riverfront civic center. In 1983, Baton Rouge hosted the International Special Olympics, and in 1985, the National Sports Festival (now called the United States Olympics) was held there. Timothy F. Reilly

See also Louisiana (pictures).

Baton twirling is a sport and recreational activity in which individuals twirl a thin metal rod called a *baton*. Baton twirlers perform and compete singly or in squads or teams. They combine intricate turns and tosses of the baton with dance and gymnastic movements. Skilled twirlers can twirl two and three batons in each hand at the same time.

Most baton twirlers use rubber-tipped batons made

Focus on Sports

A baton twirler performs during half-time at a football game. Twirlers may also compete individually or in groups in baton-twirling competitions.

of aluminum or other lightweight metal. Some baton twirlers use novelty batons with hoops, ribbons, fire, or pompons for a showy effect. Baton twirlers called *drum majors* or *majorettes* perform with marching bands at sports events and in parades. Competitions among baton twirlers are held at local, state, regional, national, and international levels.

Critically reviewed by the United States Twirling Association

Battalion. See Army, United States (table: Army levels of command).

Battelle Memorial Institute is one of the world's largest private research and development organizations. It develops, commercializes, and manages technology for industries and governments throughout the world. The institute conducts research in areas such as defense systems, design and manufacturing engineering, electronics, health and environmental problems, information systems, and materials science. The institute has 7,500 staff members and major laboratories in Columbus, Ohio; Geneva, Switzerland; and Frankfurt (am Main), Germany.

Battelle Memorial Institute was established through funds provided by the will of Gordon Battelle, an Ohio industrialist, in 1929. The institute's headquarters are in Columbus. Critically reviewed by Battelle Memorial Institute

Battenberg, *BAT uhn BUHRG,* is the name of a royal family from Hesse, in west-central Germany, which has played a part in English and Bulgarian history. Prince Alexander of Battenberg (1857-1893) became Prince of Bulgaria in 1879, after that country became self-governing. He gave up the throne in 1886.

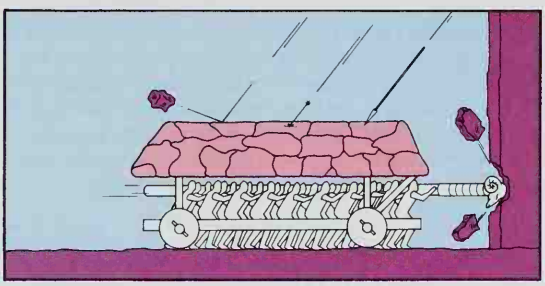
Prince Louis Alexander of Battenberg established the English branch of the family. He became a British subject, entered the Royal Navy, and, in 1884, married his cousin Victoria, granddaughter of Queen Victoria. He renounced his German title in 1917, took the name Mountbatten, and became Marquess of Milford Haven. His oldest daughter's son is Prince Philip, husband of Queen Elizabeth II. Theodore S. Hamerow

See also Mountbatten, Louis; Philip, Prince.

Battering ram was a heavy wooden beam that served as a war machine from ancient times through the Middle Ages. Soldiers used battering rams to knock down the walls and open the gates of fortified towns and castles. The forward end of the ram had a metal covering that, in some cases, was shaped like a ram's head.

The earliest battering rams were carried by men who ran at the target. The force of these rams was limited by the speed of the men and the weight of the beam they could carry. At times, rams were suspended on ropes or chains from the top of a mobile tower. Soldiers swung the suspended beam back and forth to increase the force with which it butted the target. Very large rams were mounted on wheels and pushed forward.

Battering rams were used in Mesopotamia by the 1700's B.C. The ancient Assyrians, Romans, and Greeks



WORLD BOOK illustration by Zorica Dabich

Battering rams were once used to break walls or gates of castles and fortified towns. Some rams were mounted on wheeled structures that had leather-covered roofs, *shown here.*

used them in sieges, as did the crusaders of the Middle Ages. In time, landowners built castles atop hills or surrounded by wide moats for defense against battering rams. Cannons eventually replaced the battering ram.

Richard A. Sauers

Battery. See Assault and battery.

Battery. See Army, United States (table: Army levels of command).

WORLD BOOK photo by Cameramann International, Ltd.

Batteries have many uses. The small "button" in the foreground powers a wrist watch. The large battery at the rear provides the power to start an automobile. The other batteries shown operate radios, tape recorders, toys, and other items.

Battery is a device that converts chemical energy directly into electrical energy. Batteries are used to power a variety of devices, including radios, automobile starters, and electronic equipment on satellites. Tiny batteries, such as those used in hearing aids, are less than 0.2 inch (6 millimeters) in diameter and weigh $\frac{1}{100}$ ounce (0.3 gram). The largest batteries, such as those that power submarines, can weigh over 100 tons (90 metric tons). A backup system called an *uninterruptible power supply* (UPS) uses batteries to maintain power during a utility power failure. A UPS enables computers, emergency lights, and hospital equipment to continue operating if a power loss occurs.

Batteries are manufactured in a wide range of sizes and shapes. The International Electrotechnical Commission, based in Geneva, Switzerland, sets standard sizes and minimum performance specifications for many batteries. The basic dimensions of such common sizes as D, C, AA, and AAA are thus consistent from manufacturer to manufacturer, regardless of the country in which the batteries are made. Such standardization helps ease world trade in electrical and electronic products.

How batteries work

The fundamental unit of a battery is the *electrochemical cell.* Each such cell has all the chemicals and parts needed to produce an electric current. The word *battery* actually refers to a group of connected cells. But the term is often applied to a single cell.

An electrochemical cell has two structures called *electrodes.* Each electrode is composed of a different chemically active material. The electrodes can be connected to external terminals, which, when joined by wire, complete a closed external circuit. When a cell is connected to such a circuit, an *oxidation reaction* at one electrode, called the *anode* or *negative electrode,* releases electrons to the circuit. At the other electrode, called the *cathode* or *positive electrode,* a *reduction reaction* occurs, and the electrode receives electrons from the external circuit. See **Oxidation; Reduction.**

Inside the cell, the anode and the cathode are separated by an *electrolyte.* An electrolyte is an *ionic conductor,* through which *ions* (electrically charged atoms) may move freely. The electrolyte is usually an acid, a *base* (substance that neutralizes acid), or a salt. When a closed external circuit is connected to the cell, positive and negative ions in the electrolyte move inside the cell to complete the circuit. The positive ions move from the anode to the cathode, and the negative ions move from the cathode to the anode. In this way, an electric current flows through the circuit. An electrical device, such as a light bulb, motor, or radio, can be joined to the circuit to enable the current to do useful work.

Most cells include a *separator,* a porous, nonconducting barrier that absorbs the electrolyte and prevents direct contact between the two electrodes. If the anode and cathode were to touch, the energy-producing reactions would occur inside the cell, and a current would not be available to do useful work outside the cell.

Types of batteries

There are two classes of batteries: *primary* and *secondary.* Primary batteries stop delivering electric current when their chemicals are expended. Secondary batteries—also called *rechargeable* batteries—can be recharged after use to restore them to their original charged condition. Batteries can also be categorized according to the electrolyte composition—that is, acid or base—or by their active chemical, such as lead, manganese, nickel, or zinc.

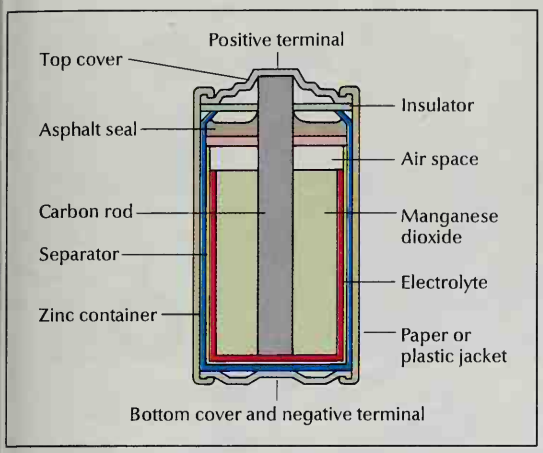
A battery's voltage is determined by the chemical energy stored in the electrode materials. *Nominal voltage* is the voltage level a battery is designed to have. A primary cell of the type used in a flashlight has a nominal voltage of 1 $\frac{1}{2}$ volts. Most secondary batteries used to start automobiles are 12-volt batteries consisting of six 2-volt cells connected in a series.

Primary batteries use chemical reactions that are largely irreversible. They cannot be recharged efficiently. But a device called a *battery charger* may extend the life of certain types of primary batteries for a short time. It recharges a cell by passing a current through it in a direction opposite to that of the flow of electric current during discharge. Primary batteries require little maintenance and retain their charge even if stored for long periods. There are four main types of primary batteries: (1) alkaline, (2) lithium, (3) carbon-zinc, and (4) air.

Alkaline batteries are the most popular type of battery. They are excellent for high-power applications and extreme environmental conditions. The term *alkaline* refers to the electrolyte, which is an *alkali* (base).

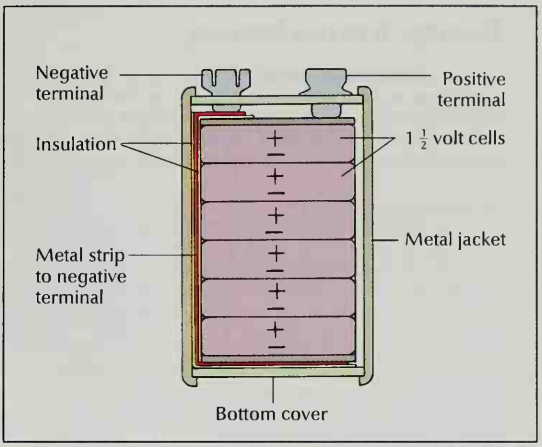
The alkaline-manganese dioxide cell is among the most common alkaline batteries. The anode consists of zinc powder *alloyed* (mixed) with small amounts of other metals. The cathode is manganese dioxide, and the electrolyte is an *aqueous* (water-based) potassium hydroxide solution. Another type of alkaline battery is the silver oxide cell. Such a cell uses zinc powder as the anode, silver oxide as the cathode, and potassium hydroxide as the electrolyte. Silver cells produce more energy than alkaline-manganese dioxide cells, but they also cost more. Their use is limited to small *button batteries* that

Parts of a carbon-zinc cell



A carbon-zinc cell consists of a zinc container filled with substances that react chemically to produce an electric current.

Parts of a 9-volt battery



WORLD BOOK diagrams

A 9-volt battery has six cells. Each produces 1 ½ volts. The cells are connected so that their total voltage equals 9 volts.

power calculators, watches, and cameras.

Lithium batteries are primary batteries with lithium metal anodes. A lithium cell produces more than twice the voltage of an alkaline cell of equal size. Lithium batteries are used in cameras, pacemakers, and watches.

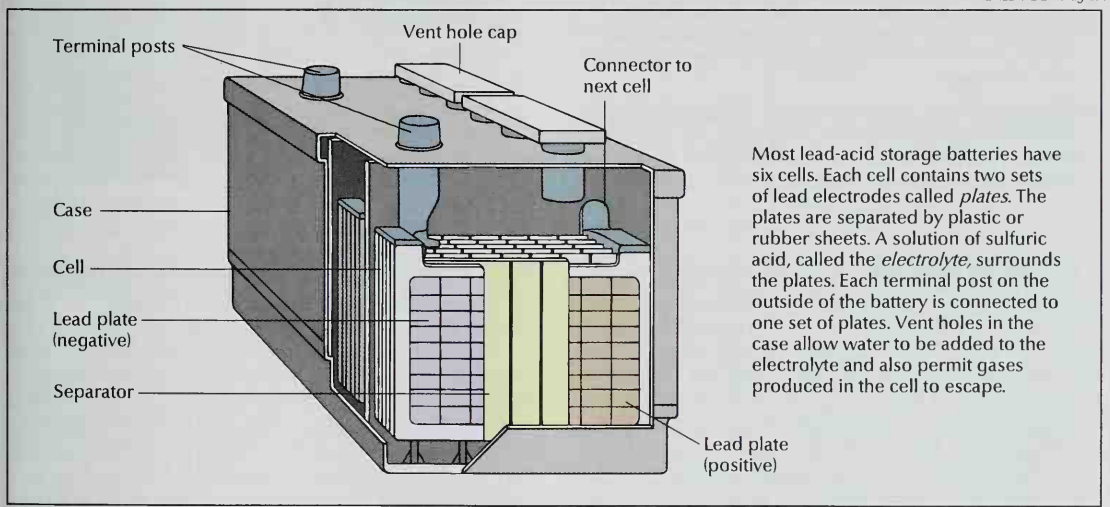
Many different cathode materials and electrolytes are used in lithium batteries. One of the highest-energy cells is the lithium-thionyl chloride cell. In this cell, a liquid mixture of thionyl chloride and lithium tetrachloroaluminate acts as the cathode and electrolyte. Lithium metal serves as the anode. A porous carbon material serves as a *cathode current collector*, which receives electrons from the external circuit.

Carbon-zinc batteries, also called *Leclanché* (pronounced *leh KLAHN SHAY*) batteries, are packaged in a zinc can that serves as both a container and the anode. The cathode is a mixture of manganese dioxide and carbon powder. The electrolyte is a mixture of zinc chloride and ammonium chloride dissolved in water. Carbon-zinc batteries are the least expensive primary batteries. They can be used in flashlights, toys, or transistor radios.

Air batteries have a zinc anode and an aqueous potassium hydroxide electrolyte. The cathode includes a *catalyst* (substance that speeds a chemical reaction) that promotes a reaction of oxygen from the air with water to form negatively charged hydroxide ions. Air batteries are open to the atmosphere, and so practical applications are restricted to locations where the atmosphere is controlled. Air batteries are used in most hearing aids. This application is effective because a hearing aid rests in the ear canal, which generally maintains a constant humidity and temperature.

Parts of a lead-acid storage battery

WORLD BOOK diagram



Most lead-acid storage batteries have six cells. Each cell contains two sets of lead electrodes called *plates*. The plates are separated by plastic or rubber sheets. A solution of sulfuric acid, called the *electrolyte*, surrounds the plates. Each terminal post on the outside of the battery is connected to one set of plates. Vent holes in the case allow water to be added to the electrolyte and also permit gases produced in the cell to escape.

A *World Book* science activity

Energy from a lemon

The purpose of this activity is to make a simple battery from two pieces of metal and a lemon, and to use several such batteries to power an electrical device. The project shows that two metals can react with an electrolyte—in this case, the citric acid in a lemon—to produce an electric current.

What you need:

To carry out this activity, you will need three lemons; a sheet of copper or some $\frac{1}{2}$-inch (12-millimeter) copper tubing; a piece of thin cardboard; aluminum foil; some thin, insulated copper wire; metal paper clips; a button-battery powered LCD (liquid crystal display) clock; electrical tape or adhesive tape; a table knife; and scissors.

Caution:

Depending on what form of copper you use, you will need to use tin snips, or a hacksaw and pliers. You should use these tools only under the supervision of an adult, or you should ask an adult to prepare the copper pieces for you. Copper can be sharp or jagged after being cut and must be handled carefully.

What to do:

1. Use scissors to cut the cardboard into three strips about $\frac{1}{2}$ inch (12 millimeters) wide and about 2 inches (5 centimeters) long. Wrap aluminum foil around the cardboard strips.

2. If you are using a copper sheet, use tin snips to cut three strips about $\frac{1}{2}$ inch wide and about 2 inches long. If you are using copper tubing, use a hacksaw to cut three 2-inch long pieces of tubing. Use pliers to squeeze one end of each section of tubing flat.

3. Cut two pieces of copper wire about 6 inches (15 centimeters) long and two pieces about 12 inches (30 centimeters) long. Have an adult strip about $\frac{1}{2}$ inch of insulation from each end of each wire.

4. Squeeze the lemons gently without breaking the skin. You may do this by rolling them on the table with the palm of your hand. Squeezing breaks some of the tiny sacs inside the lemon that hold its juice. Cut two parallel slits about an inch apart in each lemon with the table knife.

5. Insert an aluminum-covered strip into one of the slits in each of the lemons. Insert a copper strip, or the flattened end of a piece of copper tubing, into the other slit in each lemon. The pieces of metal will be the terminals of your lemon batteries. Be sure that the two metals do not touch inside the lemons.

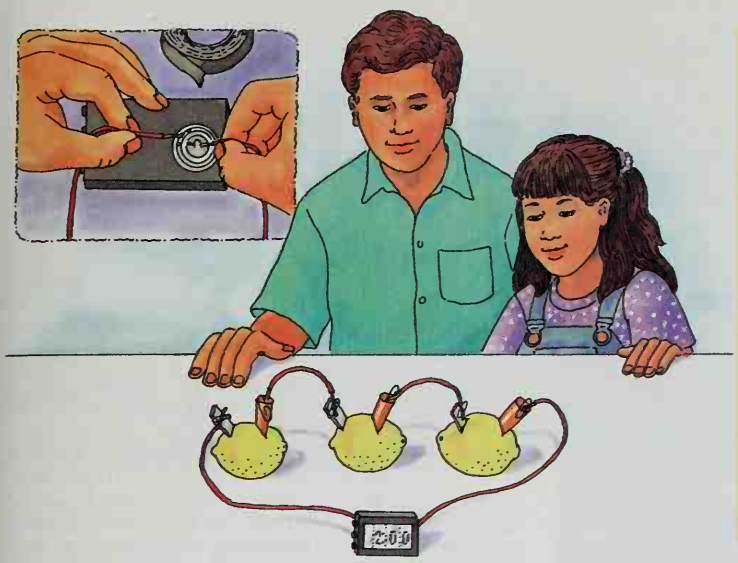
6. Use paper clips to attach a stripped end of each of the two short wires and one of the long ones to the aluminum-covered strips. Be sure that the metal of the wire is touching the metal of the strip.

WORLD BOOK illustrations by Eileen Mueller Neill

Secondary batteries have highly reversible electrode reactions. This feature allows such a battery to be recharged efficiently after use. Recharging reverses the chemical reactions at the anode and cathode, returning the battery to its original charged condition. This action can be performed hundreds of times. There are four common types of secondary batteries: (1) lead-acid, (2) nickel-cadmium, (3) metal hydride, and (4) lithium-ion.

Lead-acid batteries are used widely in automobiles. An automobile battery includes six 2-volt cells inside a plastic container. Each cell has two electrode structures called *grids*. A calcium-tin-lead alloy mesh filled with a spongy form of lead forms the negative grid. The positive grid consists of a lead-antimony alloy filled with lead dioxide. The electrolyte is sulfuric acid. In the energy-producing reaction, the spongy lead of the anode reacts with negatively charged sulfate ions in the electrolyte to produce lead sulfate. At the cathode, lead dioxide reacts with the electrolyte to produce lead sulfate.

Manufacturers have developed a lead-acid storage



WORLD BOOK illustration by Eileen Mueller Neill

7. Line the lemons up and use paper clips to connect the free ends of the short wires and one end of the unused long wire to the copper pieces as shown in the illustration.

8. Open the battery compartment of the clock and observe the position of the battery before you remove it. Make a note of which side of the battery is marked with a plus sign (+). Use tape to connect the long wire attached to the piece of copper to the clock's positive terminal, the metal part that had been touching the side of the battery with the plus sign.

9. Use tape to connect the long wire attached to the aluminum-covered strip to the clock's negative terminal, the metal part that had been in contact with the other side of the button battery.

It will take a while for the reaction to produce a high enough voltage to run the clock. If the clock does not begin running within a minute, check to make sure that the bare copper wire is in contact with the metal of each of the terminals on the lemons and on the clock.

Additional activities:
A single lemon battery produces about 0.5 volt. Most small flashlight bulbs require about 2.4 volts to light brightly. You can light a flashlight bulb by connecting additional lemon batteries to the series. By using a total of four or five lemon batteries, you should be able to light the bulb when you touch one of the two free wire ends to its base and the other to its side.

You can perform the original activity using other kinds of citrus fruits, such as grapefruit, limes, or oranges. How many of each of these fruits do you need to use to power the clock? The weaker the acid is in the fruit, the more fruit batteries will be needed to make the clock work.

battery for automobiles that does not require the periodic addition of water. This *maintenance-free battery* is sealed except for a safety valve for venting gases. It uses grids made of lead-calcium-tin alloys and lasts much longer than a standard lead-acid battery. This alloy, unlike a lead-antimony alloy, minimizes water loss.

Nickel-cadmium batteries, also called Ni-Cad batteries, are used in devices that require high power or a wide range of operating temperatures, such as cordless power tools. The cathode consists of nickel hydroxide and small amounts of cobalt. The anode is composed of cadmium metal. Porous nickel metal structures serve as the anode and cathode current collectors. The electrolyte is an aqueous potassium hydroxide solution. A Ni-Cad battery has a nominal voltage of 1.3 volts.

Metal hydride batteries use a special metal alloy that absorbs hydrogen as the anode's active material. Such an alloy can absorb over a thousand times its own volume of hydrogen. The cathode is nickel hydroxide. The anode is an alloy of nickel and lanthium, or of transition metals, which include chromium, iron, nickel, titanium, vanadium, and zirconium. The electrolyte is aqueous potassium hydroxide. Its composition does not change during the reaction. Metal hydride batteries are used in camcorders, cellular telephones, and computers. A metal hydroxide cell can produce up to 1.35 volts.

Lithium-ion batteries produce and store electrical energy by reversibly shuttling lithium ions between the anode and the cathode. The active materials have crystal structures that permit lithium ions to enter and exit without altering the structure. In most lithium-ion batteries, the anode is a carbon-based material, such as graphite or coke, and the cathode is a cobalt, manganese, or nickel oxide that includes lithium. The nominal voltage is 4.1 volts. Lithium-ion batteries are used in camcorders, cellular telephones, laptop computers, and reserve power supplies.

History

Alessandro Volta, an Italian educator in *natural philosophy* (physics), is credited with assembly of the first battery in 1799. Volta's invention became known as a *voltaic pile.* It was a layered stack of zinc and silver plates separated by linen cloth saturated with salt.

In 1836, John F. Daniell, an English chemist, introduced a more efficient primary cell. The Daniell cell had two liquid electrolytes and produced a steadier current than Volta's device. In 1859, the French physicist Gaston Planté invented the first secondary battery, a lead-acid storage battery. During the 1860's, another French scientist, Georges Leclanché, invented an early carbon-zinc primary battery. Through the years, scientists have developed smaller but increasingly powerful batteries.

Ralph J. Brodd, Daryl G. Clerc, Matthew M. Fay, and Levi T. Thompson

See also **Electric circuit; Electricity; Electrochemistry; Electrolysis; Fuel cell.**

Battle. See **Army; Navy; Air force.** See also articles on battles listed under key words, as in **Crécy, Battle of.**

Battle Creek (pop. 53,364), a city in south-central Michigan, is a health center and the world's leading producer of breakfast cereal. The Kellogg Company, the Post Division of Kraft Foods, and Ralston Foods, Inc., produce breakfast cereal there. For location, see **Michigan** (political map). Battle Creek and Kalamazoo form a metropolitan area with a population of 452,851.

Battle Creek became the headquarters of the Seventh-day Adventist Church in the latter half of the 1800's. The city's sanitarium and cereal food industries developed from the health reforms of the Adventists. W. K. Kellogg founded what is now the Kellogg Company in 1906. His brother, John Harvey Kellogg, pioneered in the development of the famous Battle Creek Sanitarium, now known as the Fieldstone Center. The former main building of the sanitarium became the Percy Jones General Hospital for veterans in World War II (1939-1945). The building is now known as the Federal Center. It is the headquarters of the Sixth United States Army Corps, the Defense Logistics Services Center, and the Civil Defense Staff College. It also houses the Defense Reutilization and Marketing Service, which distributes surplus military property. In addition to breakfast cereals, industries in Battle Creek produce automobile parts, electrical equipment, health and exercise equipment, machinery, paper products, and shopping carts.

Kellogg Company

Battle Creek is the home of Kellogg Company, which makes breakfast cereal. Kellogg's headquarters are shown above. Battle Creek is the world's largest producer of breakfast cereal.

Battle Creek was settled in 1831 and chartered in 1859. The city has a council-manager form of government.

James A. Dean

Battle Hymn of the Republic is an American patriotic song that was a popular Union rallying song during the Civil War (1861-1865). The melody comes from a hymn, "Say, brothers, will you meet us?" (also known as "Glory, hallelujah"), which was written by William Steffe, a Southerner, at least as early as 1856.

Civil War soldiers liked to create their own marching songs by singing humorous lyrics to familiar tunes. Early in the war, Union soldiers began to sing the words "John Brown's body lies a-mouldering in the grave" to the tune of Steffe's hymn. In 1861, American poet and reformer Julia Ward Howe heard an obscene version of the "John Brown" song at a Union army camp. She decided to write more appropriate lyrics and composed "The Battle Hymn of the Republic." It was published in the *Atlantic Monthly* in 1862 and soon appeared in all the Union army hymnbooks.

Katherine K. Preston

See also **Howe, Julia Ward.**

Battle of ... See articles on battles listed under their key word, as in **Waterloo, Battle of.**

Battleground National Cemetery contains the graves of 41 U.S. Army soldiers who died defending Washington, D.C., in 1864, during the Civil War. The Confederate attack on the capital ended with the Battle of Fort Stevens on July 11 and 12. President Abraham Lincoln, who was at the scene, came under enemy fire for a time. The cemetery is located at 6625 Georgia Avenue, in Washington. The U.S. government acquired the land in 1867.

Critically reviewed by the National Park Service

Battleship is a huge warship that has larger and more powerful guns and heavier armor than any other combat ship. Among fighting ships, only the aircraft carrier is larger than the battleship.

Battleships were once the dominant vessels of many of the world's navies. During World War II (1939–1945), however, they were replaced as fleet leaders by aircraft carriers. By the late 1950's, the U.S. Navy and most other navies had withdrawn battleships from active duty. But in the early 1980's, the U.S. Navy reactivated and modernized four battleships. The Navy again decommissioned these vessels in the early 1990's.

Development of the battleship began in the 1500's, when warships became heavily armed gun platforms known as *ships of the line.* Previous warships had resembled floating castles, with towers at the bow and stern from which soldiers fought in much the same way as on land. By the late 1700's, a typical ship of the line carried 74 guns and had thick oak sides.

By the mid-1800's, steam engines had supplemented sails in warships, and guns that fired explosive shells had replaced cannons and cannonballs. The oak sides of ships of the line provided little protection against these shells. As a result, navies began building vessels covered with iron. The first battle between such *ironclad* warships occurred in 1862, during the U.S. Civil War (1861-1865). The U.S.S. *Monitor* fought the Confederate ship *Virginia* (formerly the U.S.S. *Merrimack*) at Hampton Roads, Virginia. The battle, though won by neither side, marked a new age of armored battleships.

By the early 1900's, typical battleships had steel armor 16 inches (41 centimeters) thick. They were powered by steam-driven piston engines capable of propelling them at a speed of 18 knots (nautical miles per hour). Such ships carried four 12-inch guns, eight 8-inch guns, and many small, rapid-fire arms. The big guns were powerful, but extremely inaccurate. The medium-caliber guns produced most of the damage in battle.

The modern battleship. The British *Dreadnought,* completed in 1906, was the first modern battleship. It was more powerfully armed and more heavily armored than any previous warship. The *Dreadnought* displaced 20,700 short tons (18,800 metric tons) of water and measured more than 500 feet (150 meters) long. It could achieve a speed of 21 knots, and its ten 12-inch guns were more accurate than earlier big guns. Many other nations soon began building similar vessels. The only major battle of World War I (1914-1918) that involved battleships was the Battle of Jutland, fought in 1916 be-

Bettmann Archive

Battleships were the most powerful warships of World War I (1914-1918) and also were used extensively during World War II (1939-1945). The U.S.S. *Missouri, shown here,* site of the Japanese surrender in 1945, took part in many operations in the Pacific Ocean from 1944 to 1945. It also engaged in shore bombardment during the Korean War (1950-1953).

tween the British and German fleets. Both sides lost ships in the battle, and there was no clear winner.

The increased use of aircraft during World War II led to the decline in the importance of battleships. In fact, the two largest battleships ever built, Japan's *Yamato* and *Musashi,* were both sunk by aircraft in World War II. These ships displaced 64,000 tons (58,000 metric tons), carried nine 18-inch guns, and had armor 18 inches (46 centimeters) thick. U.S. battleships bombarded shore positions during the war and protected aircraft carriers from air attack. They carried nine 16-inch guns that could hurl 2,700-pound (1,200-kilogram) shells 23 miles (37 kilometers) and more than 100 antiaircraft guns.

Four U.S. battleships were used for shore bombardment during the Korean War (1950-1953). Following the war, they were placed in *mothball* (protective storage) fleets. In 1968, the battleship *New Jersey* came out of retirement briefly to fight in the Vietnam War (1957-1975).

In the 1980's, the U.S. Navy recommissioned four World War II battleships: the *New Jersey* in 1982, the *Iowa* in 1984, the *Missouri* in 1986, and the *Wisconsin* in 1988. Each was equipped with missiles and advanced radar and electronic communications and antiaircraft defense systems. The Navy decommissioned the *Iowa* in 1990, after a 1989 explosion during an exercise killed 47 sailors. The *New Jersey* was decommissioned in 1991. During the Persian Gulf War (1991), the *Missouri* and the *Wisconsin* served as missile launching platforms. They also fired shells at Iraqi military targets. The Navy decommissioned the *Wisconsin* in late 1991. The *Missouri* was decommissioned in 1992. Robert L. Scheina

See also **Bismarck; Navy, United States** (Combat ships); **Pearl Harbor** (The war memorials); **Warship.**

Baudelaire, *BOHD LAIR,* **Charles,** *shahrl* (1821-1867), was the most influential French poet of the 1800's. His bold poetry inaugurated a European literary revolution, and his art criticism and literary essays anticipate modern theories of painting and poetry.

Baudelaire's notorious collection of poems, *Les Fleurs du Mal* (*The Flowers of Evil,* 1857), traces a spiritual journey from corrupt life to purified existence. It shocked readers with its focus on death and decay, dreamy or strange pleasures, and rebellion against middle-class values. The collection, especially the sonnet "Correspondences," inspired a group of French poets known as *symbolists.* "Correspondences" describes the interplay of the five senses in creative imagination. In the second edition (1861), the section "Tableaux parisiens" ("Parisian Pictures") emphasizes the sorrows of everyday life. It stresses the poet's compassion for the poor, the aged, and the sorrows of mortal existence.

Baudelaire developed a type of literature called *prose poems,* which are printed as prose but have allegorical features and rhythm and imagery. The prose poems appeared in the collection *Petits Poèmes en prose* (1869), later called *Paris Spleen.* These works dramatize the conflict between lyrical illusion and reality.

Baudelaire defined the characteristics of modern consciousness in the essay "The Painter of Modern Life." He also wrote on German composer Richard Wagner, French painter Eugene Delacroix, and French authors Victor Hugo and Gustave Flaubert. Baudelaire established the European reputation of American writer Edgar Allan Poe by translating his stories into vivid French. Baudelaire was born on April 9, 1821, in Paris.

Edward K. Kaplan

See also **French literature; Symbolism.**

Baudouin, *boh DWAN* (1930-1993), was the fifth king of Belgium. He was born on Sept. 7, 1930, at Laeken Palace near Brussels, and he attended school in Brussels and in Switzerland. In 1940, the German army invaded Belgium and took Baudouin to Germany. Baudouin returned to Belgium in 1950 to assume the title of *prince royal.* He became king in 1951 when his father, King Leopold III, abdicated.

Baudouin married Fabiola de Mora y Aragon of Spain in 1960. On June 30, 1960, he granted independence to Belgium's African colony, the Belgian Congo (now Congo-Kinshasa). Baudouin, a popular king, helped ease tensions between the two major ethnic groups in Belgium: the Flemings and the Walloons. Janet L. Polasky

Bauhaus, *BOW hows,* was an influential school of design. It was founded in Weimar, Germany, in 1919 by the architect Walter Gropius. Teachers at the school in-

cluded such famous artists as Lyonel Feininger, Paul Klee, László Moholy-Nagy, Josef Albers, and Wassily Kandinsky. Although the Bauhaus offered courses in painting and sculpture, its main emphasis was on the applied arts. It tried to give artists a meaningful, practical place in society by training them as craftworkers or industrial designers. The Bauhaus worked to create a simple, unornamented style of design in all fields, from architecture to graphic design. Its influence is still widely seen in many aspects of modern design.

The Bauhaus also pioneered in a new kind of art education. The students began their studies with a basic design course in which they learned principles of composition and color, and how to work with different materials. Similar courses have been adopted by art schools throughout the world.

In 1925, the Bauhaus moved to Dessau because of government hostility in Weimar. It was closed by the Nazis in 1932. It tried to reopen in Berlin but was forced to close permanently in 1933. David Cateforis

See also **Architecture** (Walter Gropius; picture: The Bauhaus); **Breuer, Marcel L.; Gropius, Walter; Furniture** (The Bauhaus).

The Museum of Modern Art, New York. Gift of Knoll International

Bauhaus design greatly influenced modern furniture design. Ludwig Mies van der Rohe, a director of the school, created his famous steel-and-leather Barcelona chair in 1929.

Additional resources

Droste, Magdalena. *Bauhaus, 1919-1933.* Taschen Am., 1998.
Hochman, Elaine S. *Bauhaus: Crucible of Modernism.* 1997. Reprint. Fromm, 1999.

Baum, *bahm,* **L. Frank** (1856-1919), an American author, wrote children's books about the magical land of Oz. His first Oz book, *The Wonderful Wizard of Oz* (1900), was made into *The Wizard of Oz* (1939), one of the most popular motion pictures in history. Baum wrote 14 novels and a number of short stories about Oz, as well as other children's fantasies, filling them with many lovable and adventurous characters. After his death, other authors continued the Oz series.

Lyman Frank Baum was born on May 15, 1856, in Chittenango, New York. From 1888 to 1891, he lived in the town of Aberdeen in what is now South Dakota. He based some of the Oz adventures on his experiences on the Dakota plains. Baum also wrote plays and novels for adults. He published many of his works under different names. Jill P. May

Stock Montage

L. Frank Baum

See also **Garland, Judy; Literature for children** (picture: Fantasies).

Baum, William Wakefield Cardinal (1926-), was appointed a cardinal of the Roman Catholic Church in 1976 by Pope Paul VI. In 1980, Pope John Paul II appointed him head of the Vatican Congregation for Catholic Education.

Baum was born on Nov. 21, 1926, in Dallas. He studied for the priesthood at the Kenrick Seminary in St. Louis, Missouri, and was ordained in 1951. In 1958, he earned a Ph.D. degree from the University of St. Thomas Aquinas in Rome. In the 1960's, Baum became a leader in the *ecumenical movement,* an effort to unite all Christians. In 1970, Baum was ordained a bishop and became bishop of Springfield-Cape Girardeau, Missouri. Baum served as archbishop of Washington, D.C., from 1973 until his Vatican appointment. Robert P. Imbelli

Baumfree, Isabella. See **Truth, Sojourner.**

Bauxite, *BAWK syt,* is the ore from which almost all aluminum is produced. Bauxite contains large amounts of *hydrated aluminum hydroxide,* a chemical combination of *aluminum oxide* (Al_2O_3) and water. Aluminum oxide is also called *alumina.* Most bauxite consists of 30 to 60 percent alumina and 12 to 30 percent water. Bauxite was named for the town of Les Baux, France, where it was discovered in 1821.

The aluminum industry uses about 90 percent of the bauxite mined throughout the world. Another bauxite product, a white mineral salt called *alum,* purifies water and hardens plaster of Paris. Bricks that are designed to line blast furnaces are made of a mixture of bauxite and clay. Bauxite is also used in abrasives for grinding and polishing.

How bauxite forms. Bauxite deposits result from the chemical weathering of rocks that contain aluminum and *silica* (a compound of silicon and oxygen). Most bauxite deposits are located near the surface of the earth in regions with a hot, moist climate. In such a climate, water running slowly through the rock may remove silica but leave behind much of the aluminum.

This chemical weathering creates *boehmite, diaspore,* or *gibbsite,* minerals rich in aluminum hydroxide. Bauxite consists of one or more of these three minerals and such impurities as iron oxide, silica, and titanium oxide. The color of bauxite ranges from dark red or brown to pink or nearly white, depending chiefly on the amount of iron oxide in the ore. Most bauxite is hard and rocklike, but some is as soft as clay or dirt.

Mining and processing bauxite. Most bauxite deposits are mined by the open-pit method. First, earthmoving machines clear away the *overburden*—that is, the layer of rock and other material that covers the de-

posit. If necessary, workers then blast the ore loose with dynamite. Next, power shovels load the bauxite into trucks, which haul the ore to a processing plant, where it is crushed. Some bauxite must also be washed at the processing plant to reduce the amount of silica in the ore.

Finally, the bauxite is transported to a refinery, where a chemical process removes alumina from the ore. An electrical process called *smelting* then removes aluminum from the alumina. See **Aluminum** (How aluminum is produced).

Bauxite mining companies work to renew mined-out areas. Companies perform environmental impact studies before developing a new mine. After they have finished mining, they work to restore the area's vegetation. Plants grow back because the waste products of bauxite mining are not toxic.

The bauxite industry. Australia leads the world in bauxite production. Brazil, Guinea, and Jamaica also produce large amounts of the ore. Bauxite reserves throughout the world total about 22 billion tons (20 billion metric tons). Additional potential resources are estimated to be about 20 billion tons (18 billion metric tons).

The refining and smelting of bauxite require large amounts of electric energy. As a result, bauxite is refined and smelted chiefly in the United States and other nations where such energy is plentiful and relatively cheap. The United States produces more aluminum than any other country but has no large deposits of bauxite. Almost all the bauxite used in the United States today comes from other countries. Canada, another major producer of aluminum, imports all its bauxite.

Many bauxite deposits lie in developing countries. In 1974, 11 nations with major bauxite deposits formed the International Bauxite Association (IBA) to increase their income from the ore. IBA members have raised the price of bauxite and have levied higher taxes on bauxite-producing companies. They also have promoted the construction of bauxite refineries in their countries.

Neil W. Bliss

See also **Guinea** (picture: Mining bauxite); **Jamaica** (Economy).

Bavaria, *buh VAYR ee uh,* is a state in southeastern Germany. It covers 27,238 square miles (70,546 square kilometers) and has a population of about 11,449,000. Most of the state is a plateau surrounded and broken by mountains. The Bavarian Alps blend into the Tirolese Alps at the Austrian border. The Zugspitze, Germany's highest peak, lies in these mountains. It rises 9,721 feet (2,963 meters) above sea level. Bavaria is drained by the Danube and Main rivers.

Bavaria is a tourist region. Thousands of people visit its beautiful mountains and lakes each year. Farms in Bavaria produce such crops as barley, hay, hops, oats, potatoes, rye, and wheat. Hops are used in the production of beer, an important product of Bavaria.

Munich and Nuremberg are Bavaria's two most important cities. Munich, the largest city in Bavaria and its capital, manufactures electronic products, optical instruments, and many other products. It is a center for printing and publishing. Nuremberg, the second largest Bavarian city, is famous for its toys and gingerbread. Other important Bavarian cities include Augsburg, Würzburg, and Regensburg. Some of the famous towns

WORLD BOOK maps

Location of Bavaria

in Bavaria include Bayreuth, Oberammergau, Berchtesgaden, and Dachau.

Bavaria has been a duchy, a kingdom, a republic, and a state at various times in its history. The region was first inhabited by the Celts. It became a duchy of Germany after Germanic tribes invaded it in the 500's. Bavarian dukes ruled the duchy from 911 to 1180, when it came into the hands of the Wittelsbach family. Napoleon made Bavaria a kingdom in 1805, but it became a state of the German Empire when Germany was unified in 1871. After World War I (1914-1918), it was briefly a republic, and then part of Germany again. The Allies invaded Bavaria in World War II (1939-1945), and U.S. troops occupied it after Germany surrendered. Later, Bavaria became a West German state. West Germany and East Germany unified in 1990. Frank Ahnert

Related articles in *World Book* include:

Augsburg
Bayreuth
Ludwig II
Munich
Nuremberg
Oberammergau
Palatinate

Bavarian Succession, War of the. See Succession wars.

Bay is a part of an ocean, a lake, or a similar body of water that forms an indentation in the shoreline and is bordered by headlands or capes. Bays are commonly produced when the water level of a body of water rises above the level of the adjacent land and submerges it. For example, Chesapeake Bay and other bays along the east coast of the United States were formed when huge glaciers melted more than 10,000 years ago, causing the Atlantic Ocean to rise and flood its coastal area.

The capes or headlands that form the borders of a bay protect the shoreline within it from the powerful pounding of waves from the sea. The waves are concentrated on the capes or headlands and are then spread out within the bay itself. Soil and other materials washed away from these land formations by the action of the waves are deposited within the bay. Anthony J. Lewis

Bay Colony. See Massachusetts Bay Colony.

Bay of Bengal is the northern part of the Indian Ocean, bordering on India, Bangladesh, and Myanmar. The rivers that empty into the bay include the Ganges, Brahmaputra, and Irrawaddy. Important seaports on the bay are Kolkata, Chennai, and Yangon. The west coast of the Bay of Bengal is regular, and has few harbors. The east coast is irregular. The Andaman and Nicobar Is-

Location of the Bay of Bengal

Location of the Bay of Biscay

WORLD BOOK maps

Location of the Bay of Fundy

lands and the Mergui Archipelago lie in the eastern part of the bay. David A. Ross

Bay of Biscay is an extension of the Atlantic Ocean on the western coast of Europe. It lies west of France and north of Spain. The Bay of Biscay shoreline is about 400 miles (640 kilometers) long. The bay is about 300 miles (480 kilometers) across at its widest point.

The Bay of Biscay gets its name from the *Basques,* a people who live along the rocky Spanish shore. Leading cities on the Spanish side of the bay include Bilbao, San Sebastián, and Santander. The mouths of the Adour, Charente, Garonne, and Loire rivers are on the French side. French ports on the bay or its inlets include Bayonne, Bordeaux, Brest, Nantes, and Rochefort.

The bay is noted for its heavy storms and great storm waves. In 1588, a storm in the Bay of Biscay scattered the wooden ships of the Spanish Armada as they started out to attack England (see **Spanish Armada**). The ancient Romans called the bay the Cantabrian Sea. The French called it the Gulf of Gascony. Hugh D. Clout

Bay of Fundy is an extension of the North Atlantic Ocean that divides New Brunswick from western Nova Scotia. The bay is about 60 miles (100 kilometers) wide at its mouth. It reaches inland about 150 miles (240 kilometers), where it separates into Chignecto Bay and Minas Basin. The upper part of the bay is famous for its tides, which are the highest in the world. These tides rise and fall over a range that is sometimes greater than 50 feet (15 meters). Such massive water movement, combined with accumulation of sediment through erosion, has built up large salt marshes that serve as a feeding station for migrating shore birds. The lower Fundy also is a feeding ground for marine life, including whales.

European settlers began to arrive at the Bay of Fundy area in the early 1600's. Today, the area's economy includes fisheries for clams, herring, lobster, and scallops; livestock farming; lumber production; mining; shipbuilding; and tourism. In 1984, a 20,000-kilowatt hydroelectric generator was installed near the Nova Scotian town of Annapolis Royal in an attempt to harness the power of the bay's mighty tides. In 1985, scientists working in the upper Fundy found rare dinosaur fossils estimated to be 200 million years old. D. A. Sutherland

See also Canada (National parks); **Passamaquoddy Bay; Reversing Falls of Saint John; Tide.**

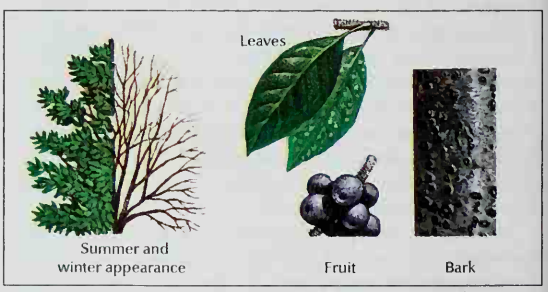
Bay of Pigs. See Cold War (The Bay of Pigs).

Bay Psalm Book was the first book known to have been both written and printed in the English colonies of America. Its full name is *The Whole Book of Psalmes, Faithfully Translated into English Metre.* Stephen Daye, a printer in the Massachusetts Bay Colony, printed the first edition of the book in 1640.

The *Bay Psalm Book* is a collection of the Biblical psalms translated from Hebrew into English. Many colonial clergymen helped translate this hymnal. They included John Cotton, John Eliot, Richard Mather, and Thomas Weld. In 1651, Henry Dunster, president of Harvard College, published a revision of the book. He prepared the revision with the aid of Richard Lyon, a Harvard tutor. The revision became popular not only in the colonies but also in England and Scotland. It appeared in at least 27 editions. Mark A. Noll

See also **Daye, Stephen.**

Bayberry, *BAY BEHR ee,* is a North American shrub closely related to the wax myrtle. It grows chiefly in coastal regions from Nova Scotia to North Carolina. Its berries are coated with a fragrant green wax that is used to make candles. Bayberry is also the name of a tree that grows in the West Indies. Manufacturers boil and use its leaves in making bay rum and cosmetics. Walter S. Judd



WORLD BOOK illustrations by John D. Dawson

The bayberry shrub grows in coastal areas of eastern North America. Its fruit is coated with a wax used in making candles.

Scientific classification. The bayberry shrub belongs to the bayberry or wax myrtle family, Myricaceae. It is classified as *Myrica pensylvanica.* The bayberry tree belongs to the myrtle family, Myrtaceae. It is *Pimenta racemosa.*

See also **Wax myrtle.**

Detail of the Bayeux Tapestry (late 1000's), embroidery on linen by unknown artists, William the Conqueror Center, Bayeux, France (Erich Lessing from Art Resource)

The Bayeux Tapestry includes a scene, *shown here,* in which the English king Harold II is killed in battle in 1066. Some scholars think Harold is standing on the left with an arrow in his eye. Others think he is the falling figure on the right.

Bayeux Tapestry, *bay YOO,* is a work of embroidery that tells, in pictures, the story of the Norman Conquest. In the Norman Conquest, William, Duke of Normandy, invaded and conquered England in A.D. 1066 by defeating the forces of the English king Harold II. Normandy is a region in northern France. William later became known as William the Conqueror.

Historians believe the Bayeux Tapestry was stitched in England during the late 1000's. Its creation was probably ordered by William's half brother Odo, who was bishop of Bayeux, a town in Normandy.

The Bayeux Tapestry is not really a tapestry, in which designs are woven into fabric. Rather, it is a work of *crewel,* a form of embroidery in which designs are made by stitching woolen threads on a background of plain cloth. In the Bayeux Tapestry, threads in shades of red, yellow, green, and blue are stitched on linen.

The Bayeux Tapestry has 73 scenes. In its present condition, it is about 20 inches (50 centimeters) high and about 230 feet (70 meters) long. But it is shorter than it once was because one end is missing. The work was intended as a wallhanging. It is kept in the William the Conqueror Center in Bayeux, France. John Gillingham

See also **England** (The Norman Conquest; picture); **Hastings, Battle of; Norman Conquest** (with picture).

Bayh, *by,* Birch Evans, Jr. (1928-), was a United States senator representing Indiana from 1963 to 1981. Bayh, a liberal Democrat, won national attention during the late 1960's for his opposition to the nation's involvement in the Vietnam War. Bayh was a candidate for the 1976 Democratic presidential nomination. His work on the Senate Judiciary Committee played a key role in the adoption of the 25th and 26th amendments to the Constitution. The 25th Amendment deals with presidential and vice presidential succession. The 26th Amendment sets the voting age at 18 for all elections.

Bayh was born in Terre Haute, Indiana. He graduated from Purdue University in 1951 and earned a law degree from Indiana University in 1960. He worked as a farmer until 1954, when he won election to the Indiana House of Representatives. He served until 1962 and was speaker of the House in 1959 and 1960. Bayh was first elected to the United States Senate in 1962. He scored an upset victory over Homer E. Capehart, a conservative Republican who had served in the Senate for 18 years. Bayh's son Evan served as governor of Indiana from 1989 to 1997. In 1998, Evan won election to the U.S. Senate from Indiana. Guy Halverson

Baykal, Lake. See Lake Baikal.

Baylor, Elgin (1934-), ranks among the outstanding all-around players in basketball history. A 6-foot 5-inch (196-centimeter) forward, Baylor played for the Los Angeles (formerly Minneapolis) Lakers of the National Basketball Association (NBA) from 1958 until his retirement in 1971.

Baylor was born in Washington, D.C. He earned All-America honors at Seattle University in 1958, and was named the NBA Rookie of the Year for the 1958-1959 season. Baylor scored 64 points in a single game against the Boston Celtics in 1959 and 71 points in a single game against the New York Knickerbockers in 1960. Both totals were NBA records at the time they were made. Baylor served as head coach of the New Orleans Jazz of the NBA from 1976 to 1979. He became director of basketball operations for the Los Angeles Clippers of the NBA in 1986. Bob Logan

Bayonet is a dagger or knife that fits on the barrel of a gun. Soldiers use the bayonet in hand-to-hand fighting.

Roger Roland Fuhr, ROLANDesign

An M6 bayonet is attached to the barrel of an M14 rifle. The *scabbard* (holder) for the bayonet is shown below the rifle.

The first bayonet appeared about 1640 and was probably a French invention. Early bayonets were short spears fitted to a plug that was inserted into the gun barrel. The name *bayonet* comes from Bayonne, France. Today's bayonets are fastened to one side of the barrel. But the usefulness of bayonets has become limited with the development of automatic weapons. Richard A. Sauers

Bayou, *BY oo* or *BY oh,* is a shallow, curving channel filled with slow-moving, sometimes stagnant water. The term was used by the French settlers of the lower Mississippi River, its delta, and the adjacent drainage areas of Louisiana, Texas, and Mississippi. It is seldom used outside that area. It may have derived from the French word *boyau,* meaning *gut* or *channel.* The word *bayou* refers to an abandoned river channel; a slow-moving stream draining a swamp or shallow lake; or an *oxbow* (horseshoe-shaped) lake. J. M. Coleman

Bayreuth, *by ROYT* or *BY royt* (pop. 71,848), is a trading center in southern Germany. It lies about 41 miles

(66 kilometers) northeast of Nuremberg. For location, see Germany (political map).

The home where the composer Richard Wagner lived in Bayreuth now houses the Wagner archives. The composer is buried in the garden at the side of his home. A festival of his operas is held every summer in Bayreuth. The grave of composer Franz Liszt, Wagner's father-in-law, is also in Bayreuth. Peter H. Merkl

Bazaar, *buh ZAHR,* is a marketplace for articles of all kinds, in which traders maintain small stalls or shops. Some bazaars occupy a single, narrow street. Others spread out through a number of streets, all of which may be roofed. The bazaar originated in early times and became a place of gossip as well as trade. In the United States and Europe, the development of flea markets is an outgrowth of the bazaar. The word *bazaar* is also often used in the United States to refer to the sale of a variety of objects to raise funds for churches, hospitals, and schools. See also Istanbul (The city). Jay Diamond

Bazooka, *buh ZOO kuh,* is a small rocket launcher. It is used against tanks, generally at short distances. A bazooka consists of a metal tube, a shoulder rest, and sometimes a *bipod* (two-legged support) for steadiness. Some are mounted on a *tripod* (three-legged support). The bazooka is usually fired from the shoulder. The United States Army's 66-millimeter caliber launcher, now called a *Light Antitank Weapon (LAW),* weighs 5 pounds (2.3 kilograms) and is 3 feet (0.9 meter) long. One person can operate the weapon. But two people, a loader and a firer, usually are used. The launcher has a smooth bore and is fired electrically. It is loaded at the breech. The 66-millimeter caliber launcher fires a rocket containing an explosive charge. The rocket can travel up to 1,100 yards (1,000 meters). The charge has a shaped cavity which forms a jet of high velocity gas. The jet enables the charge to pierce armor 1 foot (30 centimeters) thick. See also Rocket. Frances M. Lussier

U.S. Army

The bazooka may be used to halt fast-moving tanks. It launches a finned rocket similar to a small aerial bomb.

BBC. See British Broadcasting Corporation.

B.C. is the abbreviation for *before Christ.* In 532, the monk Dionysius Exiguus introduced a system of dating events, beginning with the year he believed Jesus Christ was born. In this system, the year of Christ's birth was A.D. 1, and the year before that was 1 B.C. The abbreviation *A.D.* stands for *anno Domini,* which is Latin for *in the year of our Lord.* Modern scholars believe that Christ was actually born no later than 1 B.C. However, people still determine dates using the original system.

The numbers representing "B.C." years increase as we count backward in time. Thus, 2 B.C. was the year before 1 B.C., and 2000 B.C. was the year before 1999 B.C.

Because there is no "year zero" in the dating system, the calculation of an interval between a date in a "B.C." year and the same date in an "A.D." year requires two steps: First, add the numbers representing the years. Then subtract 1. Thus, the interval between the end of 1 B.C. and the end of A.D. 1 was 1 year. The interval between the end of 2000 B.C. and the end of A.D. 2000 was 3,999 years.

An alternative system uses the same numbering method as that of Dionysius Exiguus, but does not refer specifically to Christ. In the alternative system, *C.E.,* which stands for *common era,* replaces A.D.; and *B.C.E. (before the common era)* replaces B.C. Michael Dine

See also A.D.

BCG is a vaccine used to prevent tuberculosis. It also is used experimentally in the treatment of certain cancers. BCG is prescribed extensively in many parts of the world where tuberculosis is a serious health problem.

BCG is made from specially bred and weakened strains of tuberculosis bacteria. In theory, injections of BCG cause the body to build up disease-fighting antibodies that protect against tuberculosis. BCG does not work for everyone. Furthermore, some studies suggest that BCG is ineffective among certain populations.

The French researchers Albert Calmette and Camille Guérin developed BCG in 1921. The name *BCG* stands for *B*acillus *C*almette-*G*uérin. Christopher A. Rodowskas, Jr.

Beach is an accumulation of sand, pebbles, or small rocks along a shoreline. These materials may be supplied by streams, worn away from sea cliffs, or washed up from shallow sea bottoms.

Waves and currents give beaches a variety of shapes. For example, *pocket beaches* (Halfmoon Bay, California) have a curved shape and are usually bordered by hills. *Spits* and *hooks* (Sandy Hook, New Jersey) stretch out into the water in the shape of a finger or hook. *Sedimentary capes* (Cape Canaveral, Florida) also extend into the water but are broader than spits and hooks. A beach may also be a sandy stretch that connects islands with a mainland (Marblehead, Massachusetts). Waves along low coasts may build *barrier beaches* (Miami Beach, Florida). Barrier beaches run parallel to the coastline and are separated from the mainland by a sound or lagoon.

Beaches are popular recreational spots. Well-known beach resort areas include the Riviera on the Mediterranean coasts of southern France and northern Italy, and the coasts of Florida, California, and Hawaii in the United States. David S. McArthur

See also New Jersey (picture: Grass-covered dunes at Island Beach State Park).

Beach Boys became one of the most popular groups in American rock music. They are best known for their rich vocal harmonies. Much of their music celebrates the lifestyle associated with southern California teenagers, such as surfing and hot-rod cars.

The Beach Boys were formed in the Los Angeles suburb of Hawthorne in 1961. The original members of the group were brothers Brian (1942-), Dennis (1944-1983), and Carl Wilson (1946-1998); their cousin Mike Love (1941-); and friend Al Jardine (1942-).

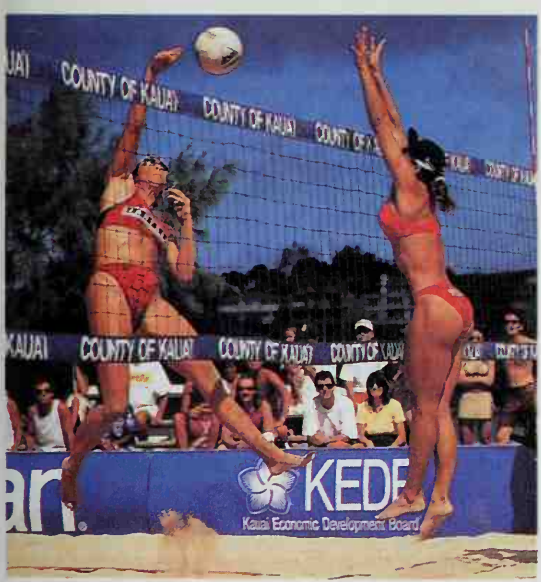
Brian Wilson was the group's pianist, bassist, and principal songwriter. Dennis Wilson and Love played drums, and Carl Wilson and Jardine played guitar. Love was the lead singer on most of the early songs. Their hits include "Surfin' " (1962), "Surfin' U.S.A." (1963), "I Get Around" (1964), "Fun, Fun, Fun" (1964), "Help Me, Rhonda" (1965), "California Girls" (1965), "Good Vibrations" (1966), and "Wouldn't It Be Nice" (1966). The group reached the height of its popularity by the mid-1960's but remained a successful touring act into the 1990's. Don McLeese

Beach plum is a wild shrub with an edible fruit that looks like a small plum. The beach plum grows on the sandy shores of the Atlantic Ocean from Maine south to New Jersey. It grows up to 10 feet (3 meters) tall. In spring, the shrub has clusters of white flowers that resemble cherry blossoms. The fruit grows in a wide range of colors, including purple, red, and yellow. It is about $\frac{1}{2}$ to 1 inch (1 to 2.5 centimeters) thick and contains a large, flat pit. The flesh of the ripe fruit is sweet and juicy, but the skin is bitter. A shrub called *sand cherry* is often mistaken for the beach plum. The sand cherry has small, bitter, black fruits. Walter S. Judd

Scientific classification. The beach plum belongs to the rose family, Rosaceae. Its scientific name is *Prunus maritima*.

Beach volleyball is a popular outdoor sport that follows the basic rules of indoor volleyball. Beach volleyball is played on sand with two players on a side. Some versions are played on grass, or with three, four, or six players on a team. The teams may be all male, all female, or *coed* (mixed). Rules vary slightly for each version.

The playing area is a rectangular court 59 feet (18 meters) long and 29 $\frac{1}{2}$ feet (9 meters) wide. A surrounding free zone must be at least 9 feet 10 inches (3 meters) wide. The court boundary lines are usually marked by flat tape, or ropes. Sometimes, the lines are drawn in the sand. The net is about 8 feet (2.4 meters) high for men and slightly lower for women. The ball is similar to the one used in indoor volleyball. Games may last for 11 or 15 points. A match may consist of one game or go to the first team to win two games.



© Markus Boesch, Allsport

Beach volleyball is a popular sport that is played outdoors on a sand court but follows the basic rules of indoor volleyball.

Beach volleyball was first played in the 1920's in the United States and became a competitive sport in California in 1947. The first world championships were held in 1976. The first sponsored professional tour started in 1980. Beach volleyball became a sport in the Summer Olympic Games in 1996. John L. Kessel

See also **Olympic Games** (table: Volleyball); **Volleyball.**

Beacon is an easily seen light or a radio signal. A beacon is used especially to aid ships or aircraft in finding a safe course. The main types of beacons for ships are lighthouses and navigational buoys.

Aeronautical beacons guide airplanes and are classified as (1) airway, (2) airport, and (3) landmark beacons. These beacons must have long-range lights; have standard color characteristics; operate from sunset to sunrise; and mark (a) a route leading to an airport or field, (b) an airport or landing field, or (c) a point for taking bearings, a landmark, or an area that presents hazards to flying.

Radio beacons on coasts help ships stay on course, especially in foggy conditions. Each radio beacon sends a signal using its own code letters. When a ship receives the signal, it turns its direction finder one way, then another, until it discovers the direction from which the signal is strongest. An officer then draws a line toward that point on a map and plots the direction of other signals in the same way. The point where the lines cross shows the location of the ship. Carol E. Stokes

Beaconsfield, Earl of. See Disraeli, Benjamin.

Beadle, George Wells (1903-1989), an American geneticist, shared the 1958 Nobel Prize for physiology or medicine for his discovery that genes act by regulating specific chemical processes. With Edward L. Tatum, he experimented with a bread mold and proved genes control chemical and enzymatic reactions in cells. Beadle was president of the University of Chicago from 1961 to 1968. He was born in Wahoo, Nebraska. Alan R. Rushton

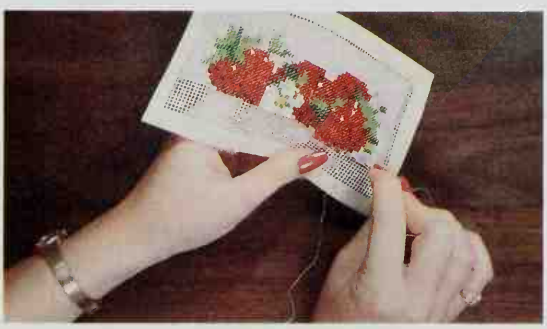
Beadle, William Henry Harrison (1830-1915), was a leader in public education in the West. He worked to prevent cheap sale of lands in the Dakota Territory that the federal government had granted for school purposes. He wrote the education article in the South Dakota state Constitution, and six other Western states closely imitated it. Beadle was born in Parke County, Indiana. He served as president of the Madison (South Dakota) State Normal School from 1889 to 1905. A statue of Beadle represents South Dakota in Statuary Hall in the United States Capitol in Washington, D.C. Eric F. Goldman

Beadwork is the craft of making or decorating objects with beads. It is used to create such accessories as belts, neckbands, and wristbands; and to decorate clothing, purses, and other items. Jewelry made from a strand of beads is not considered beadwork.

There are two kinds of beadwork, *woven* and *sewn*. Woven beadwork is created on a *beadwork loom*, which consists of a base with two upright posts. Threads

WORLD BOOK photos by Steve Hale

Beadwork is created using two methods. In *woven beadwork, above,* beads are strung on threads stretched across a hand-loom. In *sewn beadwork, below,* beads are stitched to fabric.



are stretched tightly between the posts. The weaver strings beads of the same size and shape and weaves them across the stretched threads. He or she creates designs by using beads of various colors. Sewn beadwork is created by attaching beads to a piece of fabric. The sewer may fasten one bead to the fabric at a time or string three or four beads together and then fasten them as a group. Beads of various shapes and sizes may be used. The beads may be placed in any position on the fabric.

Beadwork has been practiced in parts of Africa and Asia since ancient times. The American Indians are noted for their beadwork. Dona Z. Meilach

Additional resources

Benson, Ann. *Beading for the First Time.* Chapelle, 2001.
Coles, Janet, and Budwig, Robert. *Beads: An Exploration of Bead Traditions Around the World.* Simon & Schuster, 1997.
Dubin, Lois S. *The History of Beads.* Abrams, 1987.
Monture, Joel. *The Complete Guide to Traditional Native American Beadwork.* Collier, 1993.

Beagle is a breed of small dog. Beagles have a strong sense of smell and are sometimes used to hunt rabbits. Most are alert and friendly. The dogs can be easily trained and are popular companions for children and adults.

This sturdy dog is compact, with a short, thick coat. The beagle has a broad head and long, soft ears. Beagles weigh from 18 to 30 pounds (8 to 14 kilograms). In the United States, the beagle is bred in two sizes. Smaller beagles measure up to 13 inches (33 centimeters) tall at the shoulders. Larger beagles are from 13 to 15 inches (33 to 38 centimeters) tall.

WORLD BOOK photo by Steve Hale

The beagle is a small dog sometimes used in the sport of hunting rabbits. Beagles are intelligent and good natured, and they make excellent pets.

The beagle originated in ancient Rome. It was developed in its current form in England in the 1600's.

Critically reviewed by the American Beagle Club

See also **Dog** (picture; Hounds); **Hound**.

Beagle, a ship. See **Darwin, Charles Robert** (Darwin's life).

Beak. See **Bird** (pictures: Types of bills).

Beam. See **Bridge** (Kinds of bridges); **Building construction; House.**

Bean is the name of the seeds and pods of several related plants in the pea family. Certain kinds of beans rank among the most nourishing vegetables eaten by human beings. They yield a valuable source of protein and vitamins.

People also use beans for a wide variety of other purposes. One kind of bean, the *soybean,* is particularly useful. Oil from the soybean provides a popular kind of cooking oil. After the oil is extracted, the remainder of the seed, which is rich in protein, may serve as feed for cattle and other animals. People can make hundreds of products from soybeans, including ice cream, tofu, and artificial meat. Soybeans may even be used to make plastic bags that are *biodegradable*—that is, bags that can be broken down by nature after they are thrown away.

Some bean plants are low and bushy, while others are climbing vines. They have *compound leaves,* each of which consists of three leaflets. Their flowers resemble those of sweet peas. The large, smooth seeds grow in pods divided lengthwise into two halves. When the beans are ripe, the pods split open at the edges. Climbing beans climb by the twining action of their main stalks around poles, strings, or the stems and branches of other plants. This way of climbing differs from that

Leading bean-growing states and provinces

Bags of dry edible beans produced in a year

North Dakota	8,147,000 bags
Michigan	4,669,000 bags
Nebraska	3,693,000 bags
Minnesota	2,505,000 bags
Colorado	2,466,000 bags
California	2,458,000 bags
Idaho	2,058,000 bags
Ontario	1,378,000 bags
Manitoba	1,163,000 bags
Washington	817,000 bags

One bag equals 100 pounds (45 kilograms).
Figures are for a three-year average, 1996-1998.
Sources: U.S. Department of Agriculture; Statistics Canada.

used by pea plants. Pea plants cling to their support with curling green threads at the ends of their leaves.

Kinds of beans. People cultivate many kinds of beans throughout the world. In the United States and Canada, the most important kinds are varieties of the *kidney bean.* They were first cultivated by the Indians of South and Central America. Kidney bean varieties include the red kidney beans, the mottled pinto beans, and the white navy beans. Navy beans are used for Boston baked beans. They are often eaten after they have become fully ripe, when they are called *dry beans.*

Other varieties of kidney beans include *green shell beans.* They are picked when full-grown, but before they have ripened and turned hard. The kinds of beans called *stringless beans* or *snap beans* are picked at a still younger stage. People eat both the half-formed seeds and the juicy pods of stringless beans. Some kinds of stringless beans have green pods. Other kinds have yellow pods and are called *wax beans.*

Kidney beans of all varieties have much greater food value than most other kinds of vegetables. Dry beans provide rich sources of proteins and carbohydrates and may be eaten as a substitute for meat. Green shell beans contain large amounts of both proteins and vitamins. Stringless beans are a fairly good source of energy and are rich in vitamins A, B, and C.

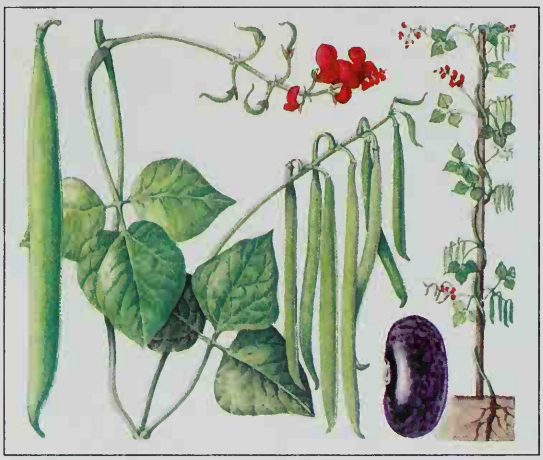
Two important beans that are not varieties of the kidney bean are the *lima bean* and the *mung bean.* The large, flat lima bean has white or green coloring. It is eaten either dried or fresh. The *mung bean* has sprouted seeds that are eaten as a cooked vegetable or raw in salads. See **Lima bean.**

Some climbing beans first found in the tropics are now grown in northern gardens for their beauty. One is the *scarlet runner bean,* with large, bright-red flowers and seeds speckled with red-and-black spots. Another is the *hyacinth bean,* which has purple flowers and handsome purplish-red seed pods.

How beans grow. Stringless bush snap beans are among the most satisfactory vegetables to grow in the home garden. Within 55 days after planting, they yield a large crop for the amount of space they require. Pole snap beans and green shell beans usually require longer than this. To have fresh beans all through the season, the home gardener should make several plantings of beans 10 to 14 days apart. Stringless beans of both the bush and pole varieties should be planted in early

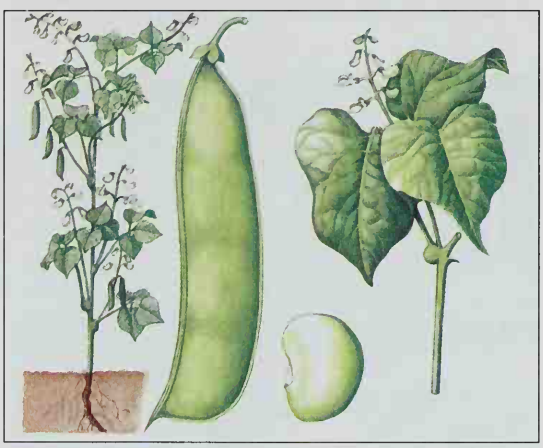
Some kinds of beans

Beans are the edible pods and seeds of certain low bushes and climbing vines. Varieties of beans include mung beans, scarlet runner beans, and soybeans. Two types that are popular with home gardeners are kidney beans and lima beans.



WORLD BOOK illustration by Kate Lloyd-Jones

Kidney beans grow on plants that bear groups of three leaflets. The flowers develop into seed pods. The seeds are black, white, brown, pink, red, or multicolored, depending on variety.



WORLD BOOK illustration by Jill Coombs

Lima beans rank among the most nutritious beans. They have a high protein value and are rich in vitamin B. Lima beans are wide and flat, and they may be green or white in color.

spring, as soon as frost is gone and the ground is warm. If it is cold, the seeds may decay. Seeds should be planted 1 to 2 inches (2.5 to 5 centimeters) deep. Pole beans are usually planted in groups of from 4 to 6 seeds. These groups of seeds are called "hills." Bush beans should be arranged in rows 2 to 3 feet (61 to 91 centimeters) apart, with the plants about 2 to 4 inches (5 to 10 centimeters) apart in the row. Commercial plantings of bush snap beans are harvested mechanically. Dry beans and stringless snap beans are also harvested mechanically.

Pests and diseases. Mexican bean beetles, aphids, and leafhoppers rank among the worst insect enemies of beans. They can be controlled with chemicals called *insecticides*. Beans also may be harmed by anthracnose, a fungal disease. Treating them with a chemical called a *fungicide* will prevent this disease. Albert Liptay

Scientific classification. Beans belong to the pea family, Fabaceae or Leguminosae. Kidney, lima, mung, and scarlet runner beans are genus *Phaseolus*. Soybeans are genus *Glycine*. The hyacinth bean is genus *Dolichos*.

See also **Bean beetle; Broad bean; Jumping bean; Nitrogen; Soybean.**

Bean, Judge Roy (1825?-1904), was a saloonkeeper and justice of the peace on the West Texas frontier, where the Pecos River and Rio Grande join. Judge Bean held his court at one end of the bar, and he often relied on his six-guns to keep order. He became noted for his colorful decisions and for his boast that he was the only "Law West of the Pecos."

Bean capitalized on the building of the Southern Pacific Railroad across the unsettled, desolate parts of southwestern Texas. He set up a saloon in the end-of-track town of Langtry, where about 8,000 workers and gamblers, rustlers, and thieves congregated. Bean had a busy time as barkeeper, justice of the peace, and coroner. His version of "Law West of the Pecos" was often odd and sometimes unfair. Once he fined a corpse $40 for carrying concealed weapons.

He fell in love with a picture of the beautiful English actress, Lillie Langtry. He claimed that Langtry was named for her and called his saloon "The Jersey Lily" in her honor. Bean arranged in 1896 to have the Bob Fitzsimmons-Peter Maher prizefight held near Langtry. He was born in Mason County, Kentucky. Dan L. Flores

Brown Bros.

Judge Roy Bean, a justice of the peace, held court in his Texas saloon. He also served as the barkeeper and the town coroner.

Bean beetle, also called *Mexican bean beetle,* is a serious insect pest that lives on bean plants. It is a kind of ladybug, but its eating habits are different from those of other ladybugs. Most ladybugs eat plant lice and other harmful insects.

Characteristics. When fully grown, the body of the bean beetle is shaped like one half of a small pea. Its entire back is covered by a pair of hard red or yellowish wings. Each wing has eight dark spots. The *larva* (young beetle) is also round and plump. However, it has no wings. The larva looks like a cucumber-shaped pincushion.

The adult bean beetles spend the winter under heaps of rubbish or in other sheltered places. In spring, the females begin to lay their yellow eggs on the undersides of leaves. In warm climates, the beetle may have four broods of larvae during one season.

The beetles and larvae eat the leaves of many kinds of beans, including bush and pole beans, lima beans, and kidney beans. Where these beans are scarce, the beetles attack such related plants as cowpeas, soybeans, sweet clover, and alfalfa.

E. R. Degginger, Animals Animals

Bean beetles, both adults and larvae, eat the leaves of many types of bean plants.

The bean beetle has long been a pest in Mexico and the West. About 1920, it was accidentally introduced into Alabama. Since then, it has spread over the central and eastern states, and into southern Canada.

Control of bean beetles. The owners of small gardens can protect their beans from damage by handpicking the beetles off the plants as soon as the pests appear. Farmers use crop rotation, varieties of plants resistant to the beetles, and other methods to reduce damage to crops. Bean beetles may be difficult to kill with insecticides because the dust or spray must reach the undersides of the leaves where the bean beetles cling. John R. Meyer

Scientific classification. The bean beetle belongs to the insect order of Coleoptera, or beetles, and the ladybug family, Coccinellidae. Its scientific name is *Epilachna varivestis*.

Bean curd. See Tofu.

Beantown. See Boston (Early settlement).

Bear is a large, powerful animal with thick, shaggy fur. Bears prey on other animals and are classified by zoologists as *carnivores*—that is, animals that eat chiefly meat. But most bear species also eat other foods, including fruit, nuts, leaves, insects, and fish.

The Alaskan brown bear is the largest carnivore that lives on land. It grows about 9 feet (2.7 meters) long and may weigh up to 1,700 pounds (770 kilograms). The sun bear, also called the Malayan bear, is the smallest bear. It is 3 to 4 feet (91 to 120 centimeters) long and weighs only 60 to 100 pounds (27 to 45 kilograms).

Most wild bears live north of the equator. They are found in Asia, Europe, and North America, and in the Arctic near the North Pole. Only one species, the specta-

David Goodnow

A mother brown bear and her cubs fish for salmon.

cled bear, lives in South America. No wild bears live in Africa, Antarctica, or Australia.

The body of a bear

Most bears have heavy bodies with long, thick fur, loose skin, and large, hairy heads. Bears have small eyes and cannot see well. Their small, rounded ears stand straight up, but they hear only fairly well. They have an excellent sense of smell. Bears have short, strong legs and large feet. Each foot has five toes, and each toe ends in a long, heavy claw. The claws can always be seen because, unlike those of a cat, they have no covering. A bear uses its claws to dig up roots, ants, termites, and other food, or to tear its prey.

A bear's walk differs from that of most other animals. Most animals walk and run on their toes. A bear, like a human being, puts the entire sole of its foot on the ground with each step and the heel of the foot strikes the ground first. The hind feet of a large bear may be 12 to 16 inches (30 to 41 centimeters) long. The large feet, the short legs, and heel-first way of stepping make bears look slow and clumsy. But bears are agile and can move fast. Polar bears can run at speeds of up to 35 miles (56 kilometers) an hour.

The life of a bear

Bears usually live alone and never gather in groups. During the mating season in the summer, a male and a female bear may live together for about a month. Then the male wanders away and the female prepares a place for her cubs to be born.

Winter sleep. Some bears spend much of the winter in a state similar to sleeping. Many scientists consider

Facts in brief

Names: *Male,* boar or he-bear; *female,* sow or she-bear; *young,* cub; *group,* pack or sloth.
Gestation period: 7 to 9 months, depending on the species.
Number of newborn: 1 to 4, usually 2.
Length of life: 15 to 30 years.
Where found: Arctic, Asia, Europe, North and South America.
Scientific classification: Bears belong to the class Mammalia, and the order Carnivora. They make up the bear family, Ursidae.

the bear's winter sleep to be an example of hibernation. Many other scientists, however, do not consider bears to be true hibernators. They point out that a bear's body temperature, unlike that of other hibernating mammals, does not drop greatly during winter sleep. In addition, a bear awakens easily and may become fairly active on mild winter days. These scientists use such terms as "winter lethargy" or "incomplete hibernation" to describe the bear's sleep period. See **Hibernation.**

A bear prepares for its winter sleep by eating large amounts of food during late summer and storing fat within its body for energy. When food becomes scarce, the bear goes to its den. The den may be a cave or a brush pile, or a burrow that the bear has dug under the roots of a large tree. Some kinds of bears may build shelters of twigs or dig shallow holes in hillsides. Female polar bears find ice caves or dig dens in the snow.

Brown bears and black bears, both of which live in regions that have harsh winters, almost always have a period of winter sleep. Species found in areas with milder winters may enter dens for only brief periods. Tropical species, such as sun bears and sloth bears, do not have a winter sleep period. Although polar bears live in the Arctic, they normally remain active during the winter. These bears spend the winter wandering the polar ice near open water and preying on seals and other marine mammals that come ashore.

Cubs. Most bear cubs are born during the mother's winter sleep period. A female bear usually has two cubs at a time, but the number may vary from one to four. The cubs weigh only $\frac{1}{2}$ to 1 pound (0.23 to 0.5 kilogram) at birth. Their eyes are closed, and they have no fur. The eyes open about a month after birth, and by that time the body is covered with thick, soft fur. The cubs stay in the den with their mother for about two months. In spring, they come out, frisky and playful. They grow rapidly and may weigh 40 pounds (18 kilograms) by autumn. Cubs stay with the mother for one or two years. She teaches them to hunt for food.

Food. Bears are meat-eating animals, but they also eat many other foods. They hunt mice, ground squirrels, and other small animals in fields and forests. They may wade into streams and catch fish with their front paws or strong jaws. Favorite foods of bears include ants, birds' eggs, and grubs (see **Grub**). Bears sometimes prey on livestock, especially lambs and young pigs. Their diet also may include acorns, berries, fruits, nuts, and the leaves and roots of plants. Bears are fond of honey and will rip apart beehives or the nests of wild bees to get it. Their long, thick fur helps protect them from bee stings.

Habits. Bears often wander far in search of food. A grizzly bear may claim an area of 10 to 12 square miles (26 to 31 square kilometers) as its private hunting ground. Polar bears swim well and are often found living on islands of ice drifting more than 200 miles (320 kilometers) from land.

Bears are usually peaceful animals. They try to avoid a fight and run from danger. They have few enemies except other bears and humans. Bears show no fear of people and often wander into camping areas looking for food. However, all bears are short-tempered and get angry quickly. They are fierce fighters and will attack anything that seems to threaten them or their cubs, food, or homes. An angry bear moves quickly in spite of its great size. One blow from its powerful front paws can kill even large animals, such as cattle and deer. The long, thick claws are also dangerous weapons. Few bears lose a fight with another kind of animal.

Wild bears live from 15 to more than 30 years. In zoos, a brown bear has lived as long as 47 years, and a polar bear for 34 years.

Kinds of bears

Zoologists traditionally recognize seven species of bears: (1) brown bears, (2) American black bears, (3) Asiatic black bears, (4) polar bears, (5) sun bears, (6) sloth bears, and (7) spectacled bears. In addition, some zoologists classify pandas as bears. But other zoologists place pandas in the raccoon family or in a family of their own. For information about pandas, see **Panda.**

Brown bears include the world's largest bears. Among them are the brown bears of Europe and Asia; Alaskan brown bears, such as the Kodiak bear and peninsula brown bear; and the grizzly bears of western North America. Brown bears vary in color from yellowish to almost black.

The brown bear of Europe and Asia appears as a character in many children's stories, where it is often named "Bruin," an old Dutch word meaning *brown.* These bears were used for hundreds of years in London for a cruel sport called *bearbaiting.* The bear was fastened to a stake and had to defend itself against vicious dogs. Cowboys in early California staged similar fights between grizzly bears and bulls. See **Bearbaiting.**

Alaskan brown bears are found chiefly on the mainland of Alaska and on Kodiak and Afognak islands off the southeastern coast of Alaska. They also live on other Alaskan islands.

Grizzly bears may grow up to 8 feet (2.4 meters) long, and they generally weigh from 250 to 600 pounds (110 to 270 kilograms). They get angry quickly, but usually do not attack unless they are threatened.

Grizzlies get their name from the white hairs that grow in their brown coats, making them look *grizzled* (streaked with gray). Grizzlies may also be called *silvertips.* A grizzly has long, curved claws that it uses chiefly to dig out ground squirrels and mice to eat. The claws are also used as weapons.

Grizzlies live mainly in Alaska and western Canada. They also are found in the mountains of Idaho, Montana, Washington, and Wyoming. About 200 grizzlies live in Yellowstone National Park. See **Grizzly bear.**

American black bears are among the most common species. They grow about 5 feet (1.5 meters) long and are the smallest bears of North America. Most black bears are from 200 to 300 pounds (91 to 140 kilograms), but some weigh up to 500 pounds (230 kilograms).

Not all black bears are completely black. Some have black coats with brown noses and white patches on the chest. Others, called *cinnamon bears,* have a rusty brown coat. The *island white bear,* or *Kermode's bear,* has creamy white fur and white claws. It lives in the coastal areas of British Columbia. The *blue bear,* also called the *glacier bear,* has gray hairs mixed with the black ones, giving the animal a bluish color. The blue bear lives in the mountains of the St. Elias Range in southeastern Alaska.

Black bears can run as fast as 25 miles (40 kilometers)

per hour when they chase prey, and they are skillful tree-climbers. These bears become troublesome around camps and cabins if food is left in their reach. Black bears have severely injured and sometimes have even killed campers or travelers who feed them.

Black bears live in many large wooded areas of North America. There are about 75,000 of them in the national forests of the United States. Many states allow people to hunt these bears, and hunters kill about 25,000 a year.

Asiatic black bears, sometimes called *Himalayan bears,* are smaller than American black bears. They grow about 5 feet (1.5 meters) long and weigh about 250 pounds (113 kilograms). Most Asiatic black bears are black, with some white hairs on the chin and a large white crescent-shaped mark on the chest. They are often called *moon bears* because of this mark.

In winter, Asiatic black bears may sleep for only short periods. They make beds of twigs in the snow so they can sun themselves. In summer, they build nestlike beds of sticks in trees, where they sleep.

Asiatic black bears are fiercer than most other kinds of bears. They often kill cattle and ponies, and sometimes attack people. These bears live in forests and brush regions throughout southern and eastern Asia. The Chinese hunt them, and many believe that the meat and bones have special healing powers.

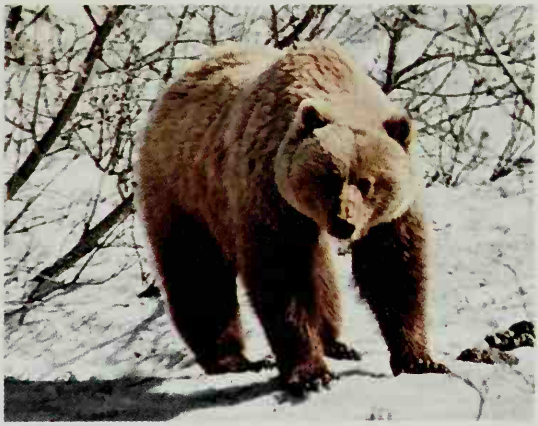
Polar bears are the best swimmers of all bears. They are only a little smaller than brown bears. They have a smaller head, but a longer, thinner neck than most other kinds of bears. The thick, heavy fur is creamy white, with a hint of yellow. A polar bear has pads of fur on the soles of its feet. The fur helps keep the feet warm and also helps the animal walk on ice.

Polar bears can move quickly in spite of their size. These bears can run up to 35 miles (56 kilometers) per hour—fast enough to catch reindeer. They can swim 3 to 6 miles (5 to 10 kilometers) per hour. Polar bears are excellent hunters, and when they are very hungry in winter, they may attack humans. Their usual prey consists mostly of sea animals, including fish, seals, and walruses. Polar bears also eat grass and dead whales that have been washed ashore. Traditionally, the Inuit (sometimes called Eskimos) hunted polar bears. They ate the meat, used the bones for many kinds of utensils, and made clothes from the hides. Some Inuit still hunt polar bears for these purposes.

Polar bears live in regions bordering the Arctic Ocean. Sometimes they ride floating chunks of ice as far as the Gulf of St. Lawrence, 750 miles (1,210 kilometers) south of the Arctic Circle. Many people have traveled to the Arctic to hunt polar bears for sport and for their hides. Such activities have greatly reduced the number of polar bears. See **Polar bear.**

Sun bears, sometimes called *Malayan bears,* are the smallest species of bears. They grow only about 3 feet (0.9 meter) long, and weigh 60 to 100 pounds (27 to 45 kilograms). Most sun bears have a black coat and a grayish or orange nose. Some have light brown feet. The bear gets its name from the white or yellow marks on its chest. Many people of ancient times believed the marks represented the rising sun.

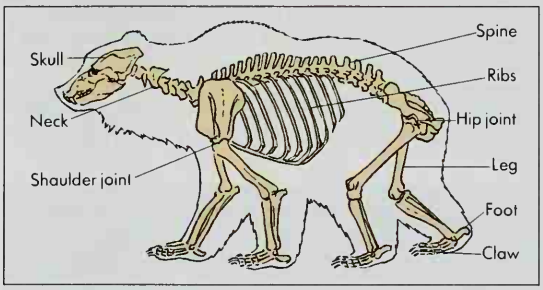
Sun bears have large paws with no hair on the soles. The claws are more curved and have sharper points than those of other kinds of bears. Sun bears usually



Leonard Lee Rue, APF

Grizzly bear

Skeleton of a grizzly bear



Grizzly bear tracks

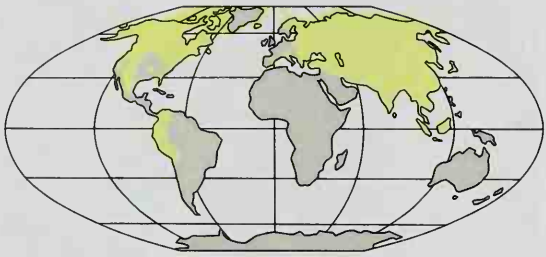
WORLD BOOK illustration by Tom Dolan

Tom McHugh, Photo Researchers

Black bear

Where bears live

The yellow areas on the map show the parts of the world in which bears live. Most bears live north of the equator.



hunt only at night. They spend the day sleeping and sunbathing in trees. They build nestlike beds in trees by bending or breaking the branches. Sun bears live in the forests of Borneo, Indochina, the Malay Peninsula, Myanmar, Sumatra, and Thailand.

Sloth bears get their name from an Old English word meaning *slow*. Sloth bears move very slowly except when disturbed. These bears are so fond of honey that they are sometimes called *honey bears*. Sloth bears grow about 5 feet (1.5 meters) long and weigh about 250 pounds (113 kilograms). Sloth bears have shaggy black fur and a white or yellow chest mark shaped like a U, V, or Y.

Sloth bears sleep in the grass, under shrubs, or in shallow caves. They hunt chiefly at night. These bears eat birds' eggs, grubs, honey, insects, and plants. They also eat termites. Sloth bears pull apart the termites' nests, blow away the dust, and suck up the insects. The bears make loud blowing and sucking noises, and hunters have little trouble finding them. Sloth bears live in India and Sri Lanka. See **Sloth bear**.

Spectacled bears are the only South American bears. They grow about 5 feet (1.5 meters) long and weigh 200 to 300 pounds (91 to 140 kilograms). They have shaggy black or blackish-brown fur. This bear is named for the large circles or half-circles of white fur around its eyes. The circles look like spectacles. The bear also has white markings on its neck and chest.

Little is known about this bear's habits, but it eats mainly fruit, leaves, and roots. The bear lives in the cool mountain forests of Bolivia, Colombia, Ecuador, Peru, and Venezuela. Overhunting and destruction of its forest home have made this bear scarce throughout much of the area. Gregory K. Snyder

See also **Animal** (pictures: Where animals live.)

Additional resources

Bauer, Erwin A. *Bears: Behavior, Ecology, Conservation.* Voyageur Pr., 1996.

Ward, Paul, and Kynaston, Suzanne. *Wild Bears of the World.* Facts on File, 1995.

Bearbaiting was a cruel sport popular in Europe and especially in London as early as 1174. It was part of holiday and Sunday activities. A bear or a bull was fastened to a stake by a chain around its neck or hind leg, and sometimes by a ring in its nose. Then large, specially trained dogs tormented it. Bearbaiting also led to other cruel amusements, such as whipping a blind bear. Bearbaiting was held in open-air arenas called *bear gardens*. Bearbaiting began to decline in the late 1600's, and in 1835 Parliament prohibited it. Don B. Wilmeth

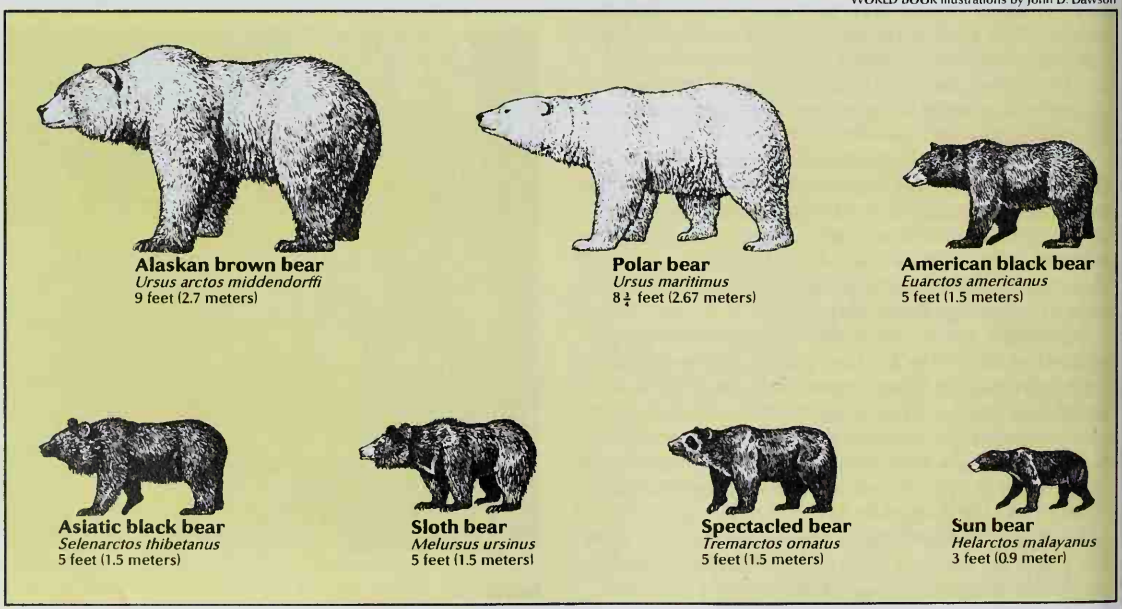
Beard is the hair that grows on a man's chin and the sides of his face. Most men shave their beard, but some let theirs grow for appearance or for other reasons. Many people regard a mustache as part of a beard.

In ancient Egypt, men shaved for cleanliness as early as 3000 B.C. Egyptian kings and queens both sometimes wore a false beard as a symbol of royalty. Socrates and

Shapes and sizes of bears

These drawings show the differences in size and body shape of bears. The sizes given are the average adult length. The scientific names of the bears appear in italics.

WORLD BOOK illustrations by John D. Dawson



other ancient Greek philosophers wore a full beard to symbolize wisdom. By A.D. 200, many European men grew a beard for appearance. Beards lost popularity about 1100 but became fashionable again during the 1500's and 1600's. Common beard styles of this period included the short *goatee* and *Vandyke*.

Many men of the 1800's grew side whiskers called *mutton chops*, with the chin shaved in the style of Emperor Francis Joseph of Austria. Beards went out of style again about 1900. They regained popularity in the 1960's and 1970's, especially among young men. Vidal Sassoon

See also **Burnside, Ambrose Everett.**

Beard, Charles and Mary, were American historians and authors. The Beards, husband and wife, were coauthors of seven books. Their best-known joint effort was a four-volume series, *The Rise of American Civilization* (1927-1943). The series expresses the belief that history is shaped by ideas as well as by social and economic events.

Charles Austin Beard (1874-1948) wrote more than 70 books on the history and foreign policy of the United States. His controversial book *Economic Interpretation of the Constitution* (1913) attracted widespread attention and influenced many other historians. In that work, Beard argued that the U.S. Constitution mainly reflects the economic interests of the men who wrote it.

Charles Beard taught history and political science at Columbia University from 1904 to 1917. He resigned in protest when the university suppressed faculty dissent over U.S. involvement in World War I (1914-1918). Beard later became known for strongly disapproving the United States entry into World War II (1939-1945). He was born on a farm near Knightstown, Ind.

Mary Ritter Beard (1876-1958) focused public attention on the role of women in history. She was the sole author of six books. Her most famous book was *Woman as Force in History* (1946). Beard became a leader in movements for women's rights and edited *The Woman Voter*, a journal that promoted *suffrage* (the right to vote) for women. She strongly influenced the development of women's studies programs in U.S. colleges and universities. Beard was born in Indianapolis. Robert C. Sims

Beard, Daniel Carter (1850-1941), was known to American Boy Scouts as "Uncle Dan." In 1905, two years before the Boy Scout movement was started in England, Beard had organized the *Boy Pioneers, Sons of Daniel Boone*. When Boy Scouting came to the United States, he became active in the new movement. He was National Scout Commissioner from 1910 until his death. His work gave the Boy Scouts of America its distinctive lore, based on pioneer and American Indian life, rather than on Indian and African life as in the British Boy Scout movement (see **Boy Scouts**).

Beard first became known as a naturalist and illustrator. His books for boys include *What to Do and How to Do It* (1882), *Shelters, Shacks, and Shanties* (1914), and *Wisdom of the Woods* (1926). He was born in Cincinnati, Ohio. Alan Keith-Lucas

Bearded collie is a breed of dog that originated in the 1500's in Scotland. The dogs were first used to herd cattle and sheep. They still occasionally serve as herding dogs today. But most bearded collies are kept as pets.

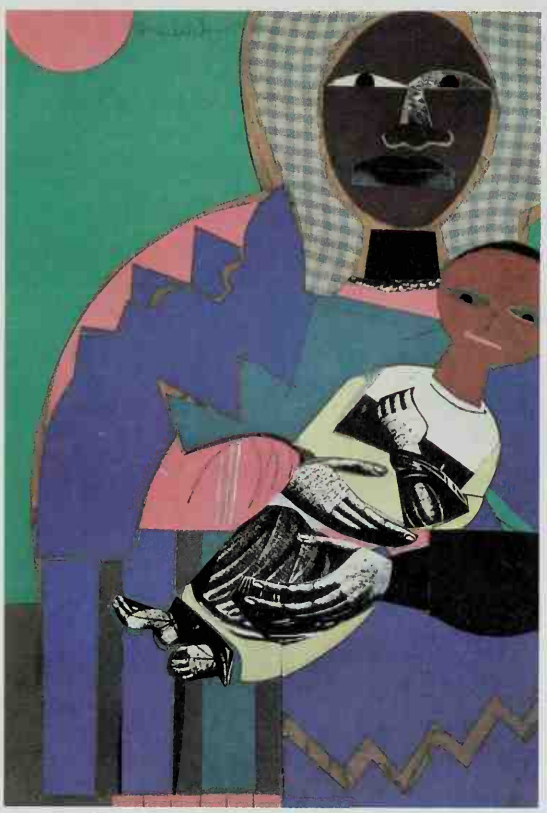
Bearded collies have a soft undercoat and a coarse, shaggy outer coat. The hair forms whiskers and a beard around the mouth. The dogs are born black, brown, blue, or yellowish-brown, usually with white markings. Most lighten in color by the time they are adults. Adult dogs measure 20 to 22 inches (51 to 56 centimeters) high at the shoulder and weigh from 50 to 60 pounds (23 to 27 kilograms).

WORLD BOOK photo

The bearded collie originated in Scotland.

Critically reviewed by the Bearded Collie Club of America

Bearden, *BIHR duhn,* **Romare,** *roh MAIR* (1914-1988), was an African-American artist whose work realis-



Collage painting (1969); Hirshhorn Museum and Sculpture Garden, Smithsonian Institution, Joseph H. Hirshhorn Bequest

Romare Bearden's painting *Black Madonna and Child* is one of the artist's distinctive images of African-American culture.

tically portrays the urban and rural life of African Americans. Bearden's works explore many aspects of African-American culture, including music, religion, home life, and street scenes. He did his best-known work in large-scale *collage* (see **Collage**). Bearden used pieces of paper, magazine cutouts, and photographic images and combined them in unique compositions.

Romare Howard Bearden was born in Charlotte, N.C. He grew up in New York City and Pittsburgh. He spent most of his adult life in New York City. Between 1938 and 1966, he served periodically as a caseworker for what is now the New York City Department of Social Services. Bearden also taught young black American painters and helped organize exhibitions of black art.

Deborah Leveton

Beardsley, Aubrey Vincent (1872-1898), was an English book and magazine illustrator. His style is typical of an art movement of the 1890's called *art nouveau* (see **Art nouveau**).

Beardsley's designs are elegant and decorative, with flowing lines, exaggerated human figures, and large contrasting areas of black and white. Many of his drawings are fantastic or grotesque, emphasizing the cruel or *erotic* (sexually stimulating) qualities he saw in his subjects. Beardsley often portrayed the world as a frightening and overwhelming place. For example, his pictures for the published version of Oscar Wilde's play *Salomé* (1894) show women who are tall, alluring, and threatening.

Beardsley was born in Brighton. He was a sickly child and began to suffer seriously from tuberculosis when he was 16 years old. Beardsley's first major work consisted of more than 500 drawings for a new edition (1892, 1894) of Sir Thomas Malory's *Le Morte Darthur*.

Beardsley was art editor of the magazine *The Yellow Book* and helped found another magazine called *Savoy*. Many of his drawings first appeared in these periodicals. Beardsley's fiction was collected and published as *Under the Hill* in 1904, after his death. Beardsley died of tuberculosis at the age of 25.

Elizabeth Broun

From *The Collected Drawings of Aubrey Beardsley*, edited by Bruce S. Harris © 1967 Crown Publishers, Inc. By permission of Crown Publishers, Inc.

A Beardsley drawing shows the exaggerated human figure and contrasting areas of light and dark that marked his style.

Beardtongue, also called *penstemon* (pronounced *pehn STEE muhn* or *PEHN stuh muhn*), is the name of a large group of showy wild and garden flowers. Most beardtongues are native to North America, especially the Western United States.

The beardtongue's flowers are tube-shaped with the ends of the petals bent back. Each flower has five *stamens* (parts that contain pollen). However, the fifth stamen of each flower produces no pollen and is often bearded with yellow hair. The colors of the beardtongue's flowers include blue, purple, rose, scarlet, and white.

Beardtongue plants are grown from seeds, parts of roots, or cuttings. Beardtongue plants grow best if they are exposed to full sunlight.

WORLD BOOK illustration by John F. Eggert

Beardtongue

Scientific classification. Beardtongues belong to the figwort family, Scrophulariaceae. They make up the genus *Penstemon*.

Donna M. Eggers Ware

Bearing is a part of a machine that supports or guides a moving part. Bearings hold weight, turn with the motion of other parts, and reduce friction and wear by enabling sliding or rotating parts to move smoothly. Bearings are used in a wide variety of machines, including automobile engines, conveyors, elevators, generators, and turbines. They are often classified according to their function. For example, *linear bearings* guide objects along a track. *Journal bearings* keep a *journal* (shaft) turning smoothly.

There are two major types of bearings—*plain bearings* and *rolling element bearings*. They differ in how they reduce friction.

Plain bearings are sometimes called *fluid film bearings* because they support moving parts on a thin film of lubricating fluid. Plain bearings form a sleeve around a shaft but are separated from it by the fluid. Many plain bearings are lined with a soft alloy called *babbitt metal* and are lubricated with grease or oil.

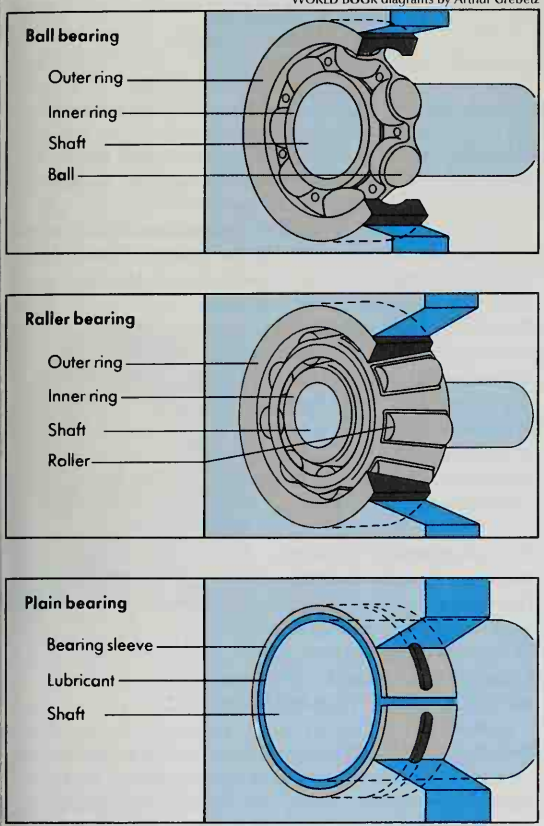
In a common type of plain bearing, the lubricant works only when the shaft is turning at high speeds. The rapid movement of the shaft creates high pressures in the lubricant, which keeps the metal surfaces from touching each other. When the machine is starting or stopping and the shaft is rotating slowly, however, the surfaces touch, producing more friction and wear.

In another type of plain bearing, lubricant is pumped in beneath the shaft at high pressure. The lubricant lifts the shaft and prevents it from touching any other surface, even during periods of slow rotation. As a result, there is almost no friction.

Common types of bearings

Bearings keep the shafts of machines turning smoothly. Bearings reduce friction between the shaft and other moving parts by means of balls, rollers, or lubricants.

WORLD BOOK diagrams by Arthur Grebetz



Some plain bearings require no lubrication because they are made of plastic or have nonmetallic liners. Self-lubricating bearings made of *sintered* (compressed and heated) metal powder are used in the electric motors in vacuum cleaners and other appliances. These bearings have many tiny pores that can be filled with lubricating oil.

Rolling element bearings use rolling motion between parts. Thus, they reduce friction better than plain bearings do. Rolling element bearings are identified by the shape of the rolling element and include *ball bearings* and *roller bearings*. Ball bearings have several steel balls that roll between two grooved steel rings. In most ball bearings, the balls are separated and held in place by a *cage* or *spacer* made of bronze, soft steel, or plastic. Roller bearings use cylindrical, spherical, or tapered rollers instead of balls. Bearings may also be manufactured in brackets or housings. W. Gene Looft

Bears and bulls are the popular names for two particular points of view among people who invest in stocks or commodities. The expressions are believed to come from the way the two animals attack. The bear attacks by sweeping its paws downward, and the bull attacks by tossing its horns up in the air. A *bearish investor* expects prices to fall and sells with the hope of being able to buy back at a cheaper price. A *bear* may also be an investor who has *sold short*—that is, sold a commodity or a security before having actual or complete possession of it. A *bullish investor* believes that prices are going to go up and buys in anticipation of a market advance.

When more people want to sell than buy, prices fall. This is called a *bear market*. When more people want to buy than sell, prices of stocks or commodities rise. This is called a *bull market*. Robert Sobel

See also Commodity exchange; Stock exchange.

Beat movement refers to a set of literary, political, and social attitudes principally associated with certain American writers and artists during the 1950's. These writers and artists were concentrated in the North Beach section of San Francisco, in the Venice West section of Los Angeles, and in Greenwich Village in New York City.

The beat movement was characterized by personal alienation and a contempt for convention. The literature of the movement celebrated stylistic freedom and *improvisation* (spontaneity). Its influences and themes included jazz, mystical Asian religions, drugs, and sexuality. The beat movement featured the uninhibited experimentation of several rebellious younger writers. Allen Ginsberg's poem "Howl" (1956) and Jack Kerouac's novel *On the Road* (1957) served as important statements of beat ideas. Other major beat writers included William Burroughs, Gregory Corso, Lawrence Ferlinghetti, and Gary Snyder.

Critics of the movement accused the "beatniks" of embracing anarchy, incoherence, and obscenity for their own sake. However, the movement did capture a generation's dissatisfaction with what it saw as the dull conformity and false values of "square" society. The beat movement also advocated peace and civil rights, which set the stage for the radical protests of the 1960's.

Arthur M. Saltzman

See also Ginsberg, Allen; Kerouac, Jack; Ferlinghetti, Lawrence; American literature (Literature since 1945).

Beatitudes, *bee AT uh toodz,* are sayings of Jesus Christ found in the New Testament. The best-known occur in the Sermon on the Mount (Matthew 5:3-12), and concern certain virtues and dispositions. They include "Blessed are the poor in spirit: for theirs is the kingdom of heaven," and "Blessed are the meek: for they shall inherit the earth."

The beatitudes in the Gospel of Luke announce comfort for the oppressed. These beatitudes include "Blessed are you poor," and "Blessed are you that hunger." The word *beatitude* comes from the Latin word *beatitudo,* which means blessedness or happiness.

Stanley K. Stowers

Beatles became the most popular group in rock music history. The group consisted of four Englishmen: George Harrison (1943-2001), John Lennon (1940-1980), Paul McCartney (1942-), and Ringo Starr (born Richard Starkey, 1940-). Lennon and McCartney wrote and sang most of the Beatles' songs. Harrison played lead guitar, Lennon played rhythm guitar, McCartney played bass, and Starr played drums.

All the Beatles were born in Liverpool. Lennon and five other musicians formed a band called the Quarrymen, named after the high school which they attended.

Fred Ward, Black Star

The Beatles were the most popular group in rock music history. They were, *left to right,* Paul McCartney, George Harrison, John Lennon, and Ringo Starr. Lennon and McCartney wrote most of the Beatles' music.

McCartney joined the group in 1957. Harrison joined Lennon and McCartney in 1958 and the three, plus bass guitarist Stu Sutcliffe and drummer Pete Best, performed together under several names. They finally called themselves the Beatles in 1960. Sutcliffe left the group in 1961, and Starr replaced Best in 1962. Brian Epstein, who ran a Liverpool record store, became their manager in 1961. The Beatles gained nationwide fame in 1962 and worldwide fame in 1964.

During the early 1960's, the Beatles' style was influenced by American rock artists, especially Chuck Berry, Buddy Holly, and the Everly Brothers. The Beatles' first compositions were simple love songs, such as "Love Me Do" (1962) and "Please, Please Me" (1963). In 1964, the Beatles toured the United States and created a sensation everywhere they performed. They starred in two popular movies, *A Hard Day's Night* (1964) and *Help!* (1965). A full-length cartoon, *Yellow Submarine* (1968), featured the music and characters of the Beatles.

During the middle and late 1960's, the Beatles helped to give rock music a new direction. Most earlier rock music had been based primarily on a strong beat, but the Beatles' music contained a new sense of melody. Their chord progressions were also more complex, and the lyrics of their songs were more imaginative and meaningful. The Beatles composed several songs of social criticism, including "Nowhere Man" (1965) and "Revolution" (1968). They also wrote such ballads as "Michelle" (1965) and "Yesterday" (1965). Other popular Beatles' songs included "Strawberry Fields Forever" (1967), "Hey, Jude" (1968), "Come Together" (1969), and "Something" (1969).

The Beatles began to drift apart in the late 1960's for a number of artistic, business, and personal reasons. The group broke up in 1970, but by that time their records had outsold those of any other popular music or rock music performers in history. After the breakup of the group, all the Beatles performed as soloists or led their own groups. In 1980, Lennon was shot to death outside his apartment building in New York City. A 25-year-old man named Mark David Chapman was convicted of the shooting. Don McLeese

See also **Lennon, John; McCartney, Paul; Rock music** (British Invasion and rock's revival).

Additional resources

The Beatles Anthology. Chronicle, 2000.
Davies, Hunter. *The Beatles.* Rev. ed. Norton, 1996.
Woog, Adam. *The Beatles.* Lucent Bks., 1998. Younger readers.

Beatrix, *BAY ah treeks* (1938-), became queen of the Netherlands in 1980. She succeeded her mother, Queen Juliana, who gave up the throne.

Beatrix, the oldest of four daughters, was born on Jan. 31, 1938, near Amsterdam. Her full name is Beatrix Wilhelmina Armgard. From early childhood, she was trained to become queen. Beatrix attended a public elementary school and later studied law, parliamentary history, and sociology at the University of Leiden. In 1961, she received a doctorate of law from the university.

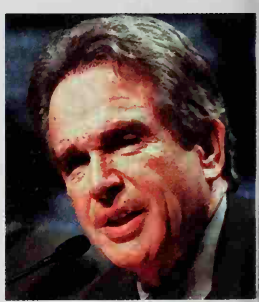
Rijksvoorlichtingsdienst

Queen Beatrix

In 1966, Beatrix married Claus von Amsberg, a German diplomat. He became Prince Claus of the Netherlands after their marriage. They have three sons—Crown Prince Willem-Alexander; Johan-Friso; and Constantijn.

Jan de Vries

Beatty, *BAY tee,* **Warren** (1937-), is an American motion-picture actor, producer, and director. Beatty gained international recognition in his debut performance as a handsome, troubled youth in *Splendor in the Grass* (1961). The first movie he produced was *Bonnie and Clyde* (1967). He also starred in this film, which told the story of two Midwestern bank robbers during the Great Depression of the 1930's. A key film of the 1960's, it began a cycle of violent movies that dominated the American cinema until the mid-1970's. Beatty's first directing experience came when he co-directed the comedy-fantasy *Heaven Can Wait* (1978), in which he also starred. He won an Academy Award for best director for *Reds* (1981), a film about American journalist John Reed. Beatty produced, directed, and starred in *Dick Tracy* (1990). He directed and starred in *Bulworth* (1998).



AP/Wide World

Warren Beatty

Beatty also played leading roles in *All Fall Down* (1962), *Lilith* (1964), *Mickey One* (1965), *McCabe and Mrs. Miller* (1971), *Shampoo* (1975), and *Bugsy* (1991). He was born on March 30, 1937, in Richmond, Virginia. His older sister is the actress Shirley MacLaine. Louis Giannetti

Beauchamp, Kathleen. See Mansfield, Katherine.

Beaumarchais, *boh mahr SHEH,* **Pierre Augustin Caron de** (1732-1799), a French dramatist, won fame for his comedies *The Barber of Seville* (1775) and *The Marriage of Figaro. The Marriage of Figaro* was finished in 1781 but banned until 1784 because of its daring attack on the insolence and privileges of the French ruling class. The comedies are noted for their witty dialogue, exciting action, and the irreverent, sparkling personality of Figaro, who is Beaumarchais's most famous character. Gioacchino Rossini wrote an opera based on *The Barber of Seville.* Wolfgang Amadeus Mozart wrote one based on *The Marriage of Figaro.*

Beaumarchais was born in Paris. He was a watchmaker, served in the French court, undertook secret diplomatic missions, and sent aid to the colonists during the Revolutionary War in America. Carol L. Sherman

Beaumont, *BOH mahnt* (pop. 113,866), became the first petroleum boom town in Texas in 1901, after a gusher at the nearby Spindletop oil field began producing crude oil. The Spindletop area, south of the city, led Texas in oil production for several years. Today, Beaumont is part of the nation's leading oil-refining district.

Beaumont lies in southeast Texas, along the Neches River. It is 20 miles (32 kilometers) north of the Gulf of Mexico. The Sabine-Neches Waterway, a deepwater channel, links the city with the gulf. With nearby Port Arthur and other communities, Beaumont forms a metropolitan area with a population of 385,090. For Beaumont's location, see **Texas** (political map).

Petroleum refineries and plants that make chemicals from petroleum form the basis of Beaumont's economy. Beaumont's other economic activities include tourism, health care, crop and livestock marketing, lumbering, rice milling, shipbuilding, criminal justice and corrections, and the production of oil field equipment and paper. Beaumont's location makes it an important shipping center for oil and other products. Huge, oceangoing tankers travel between Beaumont and the Gulf of Mexico on the Sabine-Neches Waterway. Beaumont ranks as one of Texas's busiest ports. The main campus of Lamar University is in Beaumont. Big Thicket National Preserve, which includes bayous and forests, extends north from the city.

Beaumont was founded by French and Spanish fur trappers and explorers in the late 1820's. Originally a lumbering and rice-growing center, it was chartered as a city in 1838. The seat of Jefferson County, it has a council-manager government. Louise Later Wood

Beaumont, *BOH mahnt,* **Francis** (1584?-1616), was an English playwright. He is best known for his collaboration with John Fletcher (see **Fletcher, John**).

Beaumont was born in Leicestershire of a good family. His career helped bring the theater new respectability. Beaumont wrote poetry and plays before collaborating with Fletcher from about 1608 to 1613. His play *The Knight of the Burning Pestle* (1607?) ridicules the simplicity of middle-class Londoners, their pride in their merchant guilds, and their taste for old-fashioned romance.

Beaumont and Fletcher excelled at tragicomedies with artificial romantic plots, brilliant but shallow characters, sentiment, and calculated surprise. Their works include *Philaster* (1609?), *A King and No King* (1611), and *The Maid's Tragedy* (1611?). Albert Wertheim

Beaumont, *BOH mahnt,* **William** (1785-1853), an American physician, gained fame for his studies of the process of digestion. He conducted his noted experiments on a patient with gunshot wounds in the stomach. His *Experiments and Observations on the Gastric Juice and the Physiology of Digestion* (1833) describes the experiments. Beaumont was born in Lebanon, Connecticut. Matthew Ramsey

Beauregard, *BOH ruh GAHRD,* **Pierre Gustave Toutant,** *pyair goos TAV too TAHN* (1818-1893), was a Confederate general during the American Civil War (1861-1865). He directed the bombardment of Fort Sumter, South Carolina, that started the war. His forces helped win the first Battle of Bull Run (also called Manassas), Virginia, in 1861. In 1862, he assumed command of the Confederate Army in the Battle of Shiloh (Pittsburg Landing), Virginia, after the death of General Albert S. Johnston. Beauregard defended the coasts of North and South Carolina and Georgia against naval attacks and fought at the battle for Petersburg, Virginia, in 1864.

Beauregard was born near New Orleans. He graduated from the U.S. Military Academy in 1838. He fought gallantly in the Mexican War (1846-1848). He served as chief Army engineer in New Orleans from 1858 to 1861. Then he joined the Confederate Army and soon rose to the rank of full general. After the war, he became president of the New Orleans, Jackson, and Mississippi Railroad. John F. Marszalek

See also **Civil War** (Opening battles; Battle of Shiloh; Siege of Petersburg); **Fort Sumter.**

Beautician. See **Hairdressing.**

Beauty. See **Art and the arts** (The work of art).

Beauvoir, *bohv WAHR,* **Simone de,** *see MAWN duh* (1908-1986), was a French author. She studied philosophy at the Sorbonne, where she met the philosopher and writer Jean-Paul Sartre. The ideas they shared were later called Existentialism (see **Existentialism**).

Beauvoir's Existentialist works include her first novel, *She Came to Stay* (1943), and her essay *The Ethics of Ambiguity* (1947). She also wrote plays about politics and social freedom. Her long essay *The Second Sex* (1949) discusses woman in the modern world. She frequently wrote or spoke in support of equal rights for women and ethnic minorities, improved conditions for workers, and justice for victims of war crimes.

Wide World

Simone de Beauvoir

Beauvoir wrote a four-volume autobiography. The first of these books, *Memoirs of a Dutiful Daughter* (1958), tells of her youth and early studies. In *The Prime of Life* (1960), Beauvoir recalled her experiences during the Nazi occupation of France in World War II (1939-1945). The third volume of her memoirs, *Force of Circumstances* (1963), describes postwar France until the 1954 revolution in the French colony of Algeria. She discussed her life from 1962 to 1972 in *All Said and Done* (1972). Beauvoir was born in Paris. Lynn A. Higgins

Simon, Photo Researchers

After cutting down a tree, a beaver moves it to a nearby pond.

Beaver is a furry animal with a wide, flat tail that looks like a paddle. Beavers are known for their skill at cutting down trees with their strong front teeth. They eat the bark and use the branches to build dams and *lodges* (homes) in the water. Beavers almost always seem to be busy working. For this reason, we often call a hard-working person an "eager beaver" or say that the person is "busy as a beaver."

Beavers live in rivers, streams, and freshwater lakes near woodlands. They are excellent swimmers and divers. A beaver can swim underwater for $\frac{1}{2}$ mile (0.8 kilometer), and can hold its breath for 15 minutes.

There are more beavers in the United States and Canada than anywhere else in the world. Beavers are also found in Asia and Europe. In the 1980's, trappers in the United States and Canada captured about a million beavers a year. Beaver fur is soft and shiny, and it wears well. Clothing manufacturers use it to make fur coats and to trim the collars and cuffs of cloth coats. Beaver fur is also squeezed together with other kinds of fur to make a cloth called *felt*.

Beavers were probably the most hunted animals in North America from the late 1500's through the 1800's. The pioneers and Indians ate beaver meat, and traded the furs for things they needed. In the late 1600's, a person could trade 12 beaver skins for a rifle. One beaver skin would buy four pounds of shot, or a kettle, or a pound of tobacco. Trading companies shipped beaver fur throughout the world to be made into coats or hats. Hunters killed so many beavers that hardly any were left in North America by the late 1800's. The U.S. and Canadian governments passed laws to protect the animals. Today, beavers, like many other wild animals, can be trapped only at certain times of the year.

The body of a beaver

North American beavers are 3 to 4 feet (91 to 120 centimeters) long, including the tail, and weigh from 40 to 95 pounds (18 to 43 kilograms). They are the largest *rodents* (gnawing animals) in the world except for the capybara of South America. Unlike most other kinds of mammals, beavers keep growing throughout their lives. Most beavers look larger than they really are because of their humped backs and thick fur. Thousands of years ago, some beavers of North America were about $7\frac{1}{2}$ feet

Facts in brief

Names: *Male,* none; *female,* none; *young,* kit or pup; *group,* family or colony.
Gestation period: About 3 months.
Number of newborn: 2 to 4.
Length of life: About 12 years.
Where found: Asia, Europe, North America.
Scientific classification: Beavers make up the beaver family, Castoridae. The North American beaver is *Castor canadensis.* The European beaver is *C. fiber.*

(2.3 meters) long, including the tail—almost as long as the grizzly bears. No one knows why these huge beavers disappeared.

Head. The beaver has a broad head, with large and powerful jaws. Its rounded ears and small nostrils can close tightly to keep water out. A beaver has three eyelids on each eye. Two outer eyelids, one upper and one lower, fit around the eye. A transparent inner eyelid slides down over the eye and lets the animal see under water. On land, it protects the eye from sharp twigs when the animal cuts trees. The beaver cannot see well, and depends on its keen hearing and smell to warn it of danger.

Teeth. A beaver has 20 teeth—4 strong, curved front teeth for gnawing, and 16 back teeth for chewing. The front teeth, called *incisors,* have a bright orange outer covering that is very hard. The back part of the incisors is made of a much softer substance. When a beaver gnaws, the back part of its incisors wears down much faster than the front part. As a result, these teeth have a sharp, chisel-like edge. The incisors never wear out because they keep growing throughout the animal's life. The back teeth have flat, rough edges and stop growing when the beaver is about 2 years old.

There are large gaps between the beaver's incisors and its back teeth. Flaps of skin, one on each side of the mouth, fold inward and meet behind the incisors. These skin flaps seal off the back of the mouth. They let the animal gnaw wood on land or in the water without getting splinters or water in its mouth. The flaps open when the beaver wants to eat or drink.

Feet. The beaver's legs are short, and its feet are black. Tough skin, with little hair, covers the feet. Each front paw ends in five toes that have long, thick claws. A beaver uses its claws to dig up the roots of bushes and trees for food. When swimming, the animal usually makes tight fists of its front paws and holds them against its chest. Sometimes, when a beaver swims through underwater brush or grass, it uses its front paws to push the plants aside.

The back feet are larger than the front ones, and may be 6 to 7 inches (15 to 18 centimeters) long. The toes are webbed and end in strong claws. Two claws on each foot are split. The beaver uses these split claws to comb its fur. The webbed feet serve as flippers, and help make the animal a powerful swimmer and diver.

Tail of a beaver is one of the animal's most interesting features. The stiff, flat tail looks like a paddle. It is about 12 inches (30 centimeters) long, 6 to 7 inches (15 to 18 centimeters) wide, and $\frac{3}{4}$ inch (19 millimeters) thick. A small part of the tail nearest the beaver's body has the same kind of fur as the body. The rest is covered with black, scaly skin and has only a few stiff hairs. The beaver uses its tail to steer when it swims. The tail is used as a prop when the animal stands on its hind legs to eat or to cut down trees. A beaver slaps its tail on the water to make a loud noise to warn other beavers of danger.

Fur. Beaver fur varies from shiny dark brown to yellowish brown. It looks black when wet. A beaver's coat consists of two kinds of fur: (1) short, soft underfur; and (2) long, heavy guard hairs. The guard hairs lie over the underfur and protect it. The underfur helps keep a beaver comfortable in the water. This fur traps air and holds it close to the animal's skin. The trapped air acts as a protective blanket that keeps the beaver warm, even in icy water.

The life of a beaver

Beavers usually live in family groups. As many as 12 beavers may make up a family, but generally there are 6

The body of a beaver

Hans Reinhard, Bruce Coleman Inc.

Front foot

© V. B. Scheffer, Photo Researchers

Hind foot

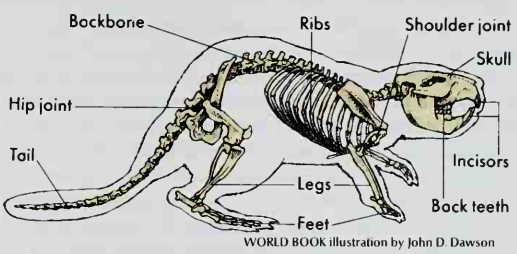
© Leonard Lee Rue III, Photo Researchers

Front teeth

© V. B. Scheffer, Photo Researchers

Scales on tail

The skeleton of a beaver



WORLD BOOK illustration by John D. Dawson

Beaver tracks

WORLD BOOK illustration by Tom Dolan

A beaver colony bustles with activity. Beavers cut down trees to build a dam and repair their lodge. They store food in a cache for winter, and take twigs into the lodge for the young.

or fewer. The group includes the adult male and female, the young born the year before, and the newborn.

Beavers live as long as 12 years. Their enemies include bears, lynxes, otters, wolverines, wolves, and people. A beaver avoids these enemies by living in the water and by coming out mostly at night to eat or work.

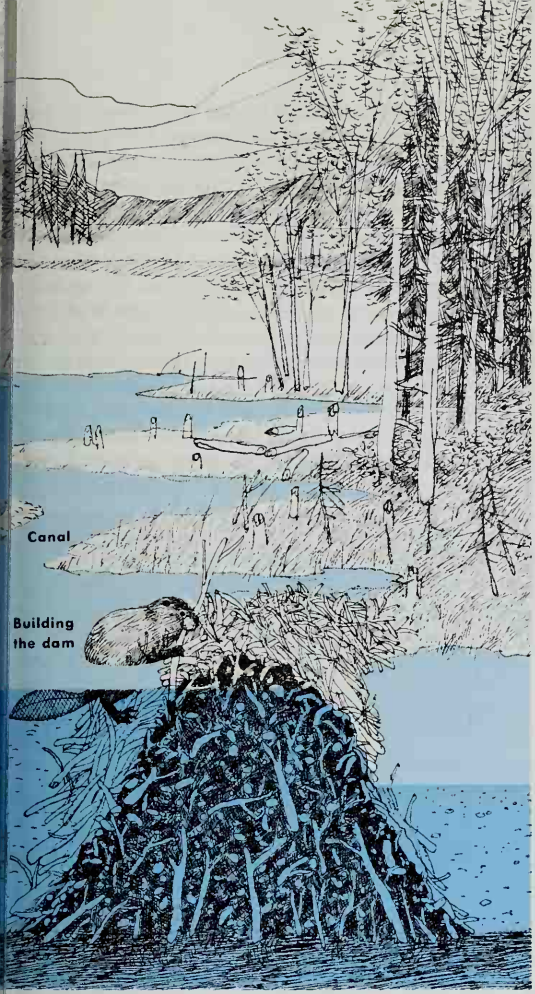
The young. A female beaver carries her young inside her body for about three months before they are born. She has two to four babies at a time. Most young beavers, called *kits* or *pups,* are born in April or May. A newborn kit is about 15 inches (38 centimeters) long, including its tail, and weighs $\frac{1}{2}$ to $1\frac{1}{2}$ pounds (0.2 to 0.68 kilogram). The tail is about $3\frac{1}{2}$ inches (8.9 centimeters) long. A kit has soft, fluffy fur at birth, and its eyes are open.

The young live with their parents for about two years, and then are driven from the family group. These young adults are forced out to make room for the newborn. Beavers rarely fight with each other except in spring, when the 2-year-olds are driven away.

Food. Beavers eat the inner bark, twigs, leaves, and roots of trees and shrubs. Poplar trees, especially aspens and cottonwoods, and willow trees are among their favorites. One acre (0.4 hectare) of poplars can support a family of six beavers for one to two years. Beavers also eat water plants, and especially like the roots and tender sprouts of water lilies.

Beavers store food for winter use. They anchor branches and logs in a *cache* under the water near their lodges. In winter, they swim under the ice and eat the bark.

Cutting down trees. A beaver uses its strong front teeth to cut down trees and to peel off the bark and the branches. To cut a tree, the beaver stands on its hind legs and uses its tail as a prop. It places its front paws on the tree trunk, and turns its head sideways. Then the beaver bites the trunk to make a cut in it. The animal makes another cut farther down on the trunk. The distance between the two cuts depends upon the size of the tree. The cuts are farther apart on large trees than on small ones. The beaver takes several bites at the cuts to make them deeper. Then the animal pulls off the piece of wood between the cuts with its teeth. It keeps cutting and tearing out pieces of wood until the tree falls. Beavers usually cut the wood away around a tree trunk, but they may cut through the trunk from only one side.



WORLD BOOK illustration by George Suyeoka

A beaver cannot control the direction in which the tree falls. It cuts until the trunk starts to break, and then runs to safety. The animal usually dives into the water nearby. It waits there until it is sure that no enemies have been attracted by the noise of the falling tree. Then the beaver goes back to work on the tree.

First the animal gnaws the branches off the tree. Then it carries, drags, pulls, pushes, or rolls the log into the water. The beaver stores some branches deep in the water for use as food during the winter. The other branches may be used to enlarge or repair the dam and the lodge. Beavers often work alone, but sometimes several work together.

Building dams and canals. The beaver's habits of building and of storing food seem to be *instinctive* (unlearned). A beaver cuts down trees even if it has no place to build a dam or a lodge, and even if it has more than enough food.

A whole beaver family, and sometimes beavers from other families, may join in building a dam. Beaver dams are made of logs, branches, and rocks plastered together with mud. Beavers use mud and stones for the base of a dam. Then they add brush and log poles. They strengthen the dam by placing the poles so that the tips lean in the same direction as the water flows. The beavers plaster the tops and sides of the poles with more mud, stones, and wet plants. They do most of this work with their front teeth and front paws. They bring mud from the river bottom by holding it against their chests with their front paws.

The beavers build their dam so that the top is above the water. Some dams are more than 1,000 feet (300 meters) long. Beavers may keep their dams in good condition for many years. Most beavers that live in lakes do not build dams, but some build dams across the outlets of small lakes.

A beaver marks its territory with *castors,* small piles of mud mixed with the beaver's scent. The castor glands of beavers are used in making perfume.

Sometimes beavers dig canals so they can move logs to their dams or lodges easily and quickly. The canals are 12 to 18 inches (30 to 46 centimeters) deep, 18 to 24 inches (46 to 61 centimeters) wide, and may be more than 700 feet (210 meters) long. A beaver canal may extend from a wooded area to a lake or riverbank. Or it may cut across a piece of land that sticks out into the water.

Building lodges. A beaver lodge looks somewhat like a tepee. A family of beavers builds its lodge with the same materials and in much the same way as it builds a dam. The lodge may stand on the riverbank or in the water like an island. The tops of most lodges are 3 to 6 feet (91 to 180 centimeters) above the water. Each lodge has several underwater entrances and tunnels, all of which lead to an inside chamber. The floor of the chamber is 4 to 6 inches (10 to 15 centimeters) above the water. Here, young beavers can stay warm and dry in winter, and the adults can dry off after bringing in food. Holes between the branches in the ceiling let in fresh air.

The size of the lodge depends on the size of the family and the length of time the beavers have lived there. The animals enlarge and repair the lodge as long as they live in it. Most beavers abandon their lodge only if they have eaten all the food in the area, or if too many enemies move nearby.

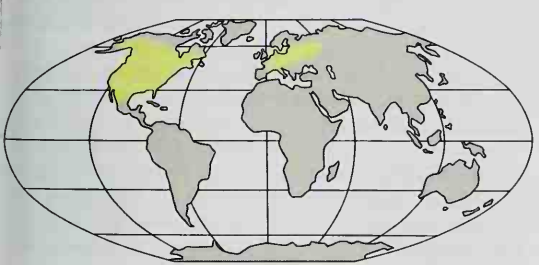
Beavers that live in large lakes or in swift rivers may dig dens in the banks. These beaver dens, like the lodges, have underwater entrances and tunnels.

Charles A. Long

See also **Animal** (picture: Animals of the temperate forests); **Fur**; **Trapping.**

Where beavers live

The yellow areas in the map, *below,* show the parts of the world in which beavers are found. Most beavers live in North America.



Beaverbrook, Lord (1879-1964), created a great British press empire, acquired a fortune, and became a political power in Britain. He made the *Daily Express,* his London newspaper, one of the most lively and widely read daily papers in the world. William Maxwell Aitken was born in Canada, in Maple, Ontario. He settled in London in 1910 and was a member of Parliament from 1910 to 1916. He was made Lord Beaverbrook in 1917. In 1918, he served as minister of information. Beaverbrook supported free trade among members of the British Empire. During World War II (1939-1945), he was minister of aircraft production. Keith Robbins

Bebel, *BAY buhl,* **August** (1841-1913), was a leading German socialist of the 1800's and early 1900's. Bebel was born into a working-class family in Cologne, Germany, and orphaned early in life. He became a woodworker and settled in Leipzig. There, Wilhelm Liebknecht, a German socialist, introduced him to the ideas of Karl Marx, the founder of Communism.

During the 1860's, Bebel struggled against the widely accepted ideas of Ferdinand Lassalle, another leading socialist. Lassalle and his followers believed government should carry out social and economic reforms. Bebel thought change should come from the workers.

In 1869, Bebel helped organize a socialist party called the Social Democratic Party, which he headed until his death. In 1871, he became the first socialist member of the *Reichstag,* the lower house of the German parliament. The government blocked his efforts to build a public socialist party, outlawing socialist organizations from 1878 to 1890. However, the Social Democratic Party continued as an underground organization. After 1890, when it could again operate openly, it became one of Germany's strongest parties. Helmut Gruber

Bechet, *buh SHAY,* **Sidney** (1897-1959), was an American jazz clarinetist and soprano saxophone player. Bechet's driving, passionate playing, primarily in the New Orleans style, was widely influential.

Bechet was born in New Orleans. He began his career as a teen-ager, playing clarinet during the early years of jazz. In 1919, he traveled to Europe. While in London, Bechet adopted the soprano saxophone as his principal solo instrument. In the 1920's, Bechet performed in both Europe and the United States. He played with the day's top jazz musicians, including Duke Ellington and James P. Johnson. Bechet's recordings with Louis Armstrong in 1924 and 1925, including "Cake Walking Babies," are some of the most important jazz statements of the period. During the 1930's, Bechet's career faded as jazz tastes turned away from the New Orleans style. He regained his popularity about 1939 with the revival of interest in New Orleans jazz. In 1951, he became a permanent resident of France, where he was treated as a national celebrity. Frank Tirro

Becker, Boris (1967-), is a German tennis champion. In 1985, Becker surprised the tennis world by winning the men's singles title at the All-England (Wimbledon) Championships. He became the youngest man and first German to win the men's championship. He also won the Wimbledon title in 1986 and 1989. Becker won the U.S. Open in 1989 and the Australian Open in 1991 and 1996. He played on the West German team that defeated Sweden to win the Davis Cup in 1988. He is known for his powerful serve and acrobatic shotmaking.

Becker was born in Leimen, near Heidelberg. He became a professional tennis player immediately after he graduated from high school in 1984. Arthur Ashe

Becket, Saint Thomas, also known as Thomas à Becket (1118?-1170), was an archbishop of Canterbury. His struggle to keep the English church free from royal control led to his dramatic death.

Becket was born in London and studied in England and France. About 1143, he entered the service of Theobald, archbishop of Canterbury, under whom he held various church offices. In 1155, King Henry II appointed Becket chancellor of England. Becket adopted a luxurious life style and became Henry's favorite companion. In 1162, Henry made Becket archbishop of Canterbury. Becket took his new position seriously. He lived more simply and became a champion of the church against royal power.

A series of bitter conflicts followed between Becket and Henry over the king's attempts to gain control of the church in England. Becket resisted Henry's efforts to collect taxes from landowners and on church lands, and to try church officials accused of serious crimes. In 1164, fearing for his safety, Becket fled to France, but he returned to England in 1170 and quickly renewed his opposition to royal authority. Becket's new defiance irritated the king. In the hearing of his knights, Henry asked if anyone was brave enough to rid him of a single troublesome priest. Four knights took Henry's remark as a royal request. The knights murdered Becket while he was at evening prayers in Canterbury Cathedral.

Pope Alexander III declared Becket a saint in 1173. Becket's tomb at Canterbury quickly became a popular place of pilgrimage. Becket's feast day is December 29, the date of his assassination. William J. Courtenay

See also **Henry II** (king of England).

Beckett, Samuel Barclay (1906-1989), was an Irish novelist, playwright, and poet. He received the Nobel Prize for literature in 1969.

Beckett was born in Foxrock, a suburb of Dublin. He graduated from Trinity College in Dublin in 1927 and joined the literary circle that surrounded Irish novelist James Joyce in Paris. Beckett's first novel, *Murphy* (1938), displays an exuberant language that reflects Joyce's influence. In 1937, Beckett settled in France.

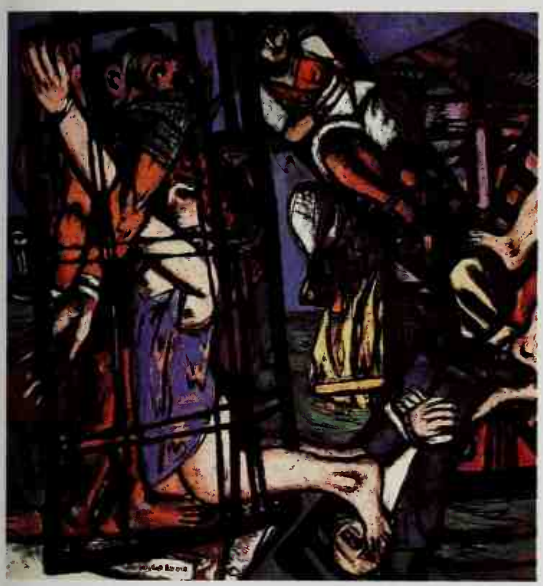
After World War II ended in 1945, Beckett began to write major works in French, including his trilogy of novels, *Molloy, Malone Dies,* and *The Unnamable* (1951-1953). He continued to write in both English and French, translating his works from one language to the other. Beckett's play *Waiting for Godot* (1953) established him as the principal figure in the international literary and theatrical *avant-garde* (see **Avant-garde**). A series of celebrated dramas followed, including *Endgame* (1957), *Krapp's Last Tape* (1958), *Happy Days* (1961), *Play* (1963), *Not I* (1973), and *Rockaby* (1981). Beckett, who also wrote for radio and television, became the most influential playwright of his generation. The impact of his writing may be seen in the plays of Harold Pinter, Tom Stoppard, Edward Albee, and Sam Shepard.

Beckett's work was consistently radically experimental. His fiction and drama became increasingly simplified in the elimination of all but a few details. One main image occurs throughout his works, an aging person struggling with his or her perception of the surrounding

environment. As images of the past revolve in the imagination of these figures, they question their identity and the authenticity of their being. Charles R. Lyons

Beckmann, Max (1884-1950), a German artist, became known for his expressionistic images of brutality and terror. Beckmann's works exhibit a harsh yet precise representation of the external world. At the same time, he distorted reality to intensify the symbolic content and emotional impact of his paintings. Beckmann's most significant works include a number of self-portraits and a series of *triptychs,* which are paintings made up of three connecting panels.

Beckmann was born in Leipzig. He was deeply influenced by the violence and horror he observed while serving in the medical corps in 1914 and 1915 during World War I. During the 1920's, Beckmann and German artists Otto Dix and George Grosz sought to create a more realistic style of art that would address social issues. The style became known as the *New Objectivity.* When the Nazis came to power in Germany in 1933, they labeled Beckmann a "degenerate artist" and stripped him of the teaching position he had held since 1925. In 1937, Beckmann fled to Amsterdam and lived there in hiding from the Nazis. In 1947, he moved to the United States, where he spent the rest of his life.



Portland Art Museum, Portland, Ore.

A Beckmann painting called *The Mill* shows the strong black lines and heavy figures packed into tight spaces that are typical of his style. Beckmann painted the picture in 1947, late in his career.

Rebecca Jeffrey Easby

Beckwourth, James Pierson (1798-1867?), an American frontiersman, discovered Beckwourth Pass in the Sierra Nevada about 1850. The pass opened a route to California's Sacramento Valley.

Beckwourth was born in Fredericksburg, Va., probably a slave. He grew up in St. Louis, undoubtedly free. He took part in Ashley-Henry fur-trading expeditions into the Rocky Mountains from 1823 to 1826, and lived with Crow Indians from 1826 to 1837. He served as an Army scout in the mountain area and ran trading posts there from 1837 to 1850. After he found the pass that bears his name, Beckwourth started a ranch nearby. His autobiography, *Life and Adventures of James P. Beckwourth* (1856), exaggerates his daring but gives a good description of mountain life. Edgar Allan Toppin

Becquerel, *beh KREHL* or *behk uh REHL,* **Antoine César,** *ahn TWAHN say ZAHR* (1788-1878), was a French physicist who performed pioneering experiments in electricity and electrochemistry. His many inventions include the first constant-current electric pile, the electromagnetic balance, and the thermoelectric needle, which measures internal body temperature. He discovered that the energy developed by contracting muscle tissue is transformed into heat.

Becquerel was born in Loiret, and studied science at the École Polytechnique in Paris. After 1837, he was a professor of physics at the Museum of Natural History in Paris. His sons, Louis Alfred Becquerel and Alexandre Edmond Becquerel, were also distinguished scientists. Alexandre's son, Antoine Henri Becquerel, shared the 1903 Nobel Prize for physics for his work on radioactivity. Richard G. Olson

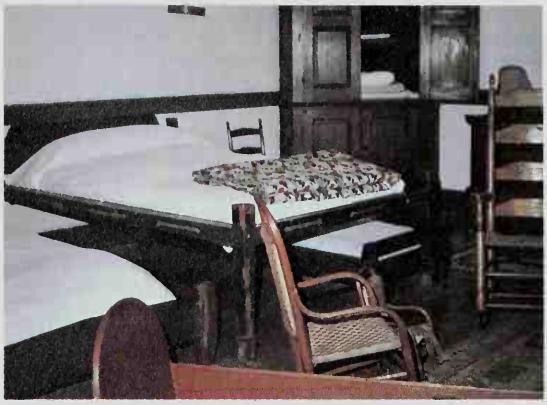
Becquerel, *beh KREHL* or *behk uh REHL,* **Antoine Henri,** *ahn TWAHN ahn REE* (1852-1908), was a French physicist. He shared the 1903 Nobel Prize for physics with Pierre and Marie Curie for his discovery of natural radioactivity. In 1896, Becquerel found that rays coming from a uranium ore affected a photographic plate in the same manner as X rays. These rays did not seem to be related to any external source of energy, such as the sun, and were more powerful than the radiation from pure uranium. Following his suggestion, the Curies worked on the substance pitchblende and isolated from it the chemical element radium (see **Curie, Marie S.; Curie, Pierre**).

Becquerel was born in Paris. His father and grandfather also were physicists. Becquerel studied at the École Polytechnique and graduated as an engineer from the École des Ponts-et-Chaussées. In 1892, he became professor of physics at the Museum of Natural History, and in 1895 took the same position at the École Polytechnique. He was elected president of the French Academy of Sciences in 1908. Richard G. Olson

Bed is an article of furniture used for sleeping or resting. Throughout history, beds have ranged from simple, straw-filled mattresses to elaborate pieces of furniture decorated with rich fabrics. Like other furniture, beds often have served as symbols of social rank and wealth.

Types of beds. Most modern beds consist of a frame, also called a *bedstead.* Accessories called *bedding* are usually added. They generally include a mattress, sheets, blankets, and pillows. A *water bed* is a frame bed with a mattress consisting of a vinyl bag filled with water. *Dual-purpose beds* can be used as another type of furniture. For example, some serve as sofas when not in use. A *Murphy bed* folds up on hinges into a closet. Not everyone sleeps on a frame bed and mattress. In Japan and Latin America, many people sleep on straw mats laid on the floor. Some people in hot climates sleep in hammocks.

History. Early civilizations had beautifully decorated beds. The ancient Egyptians, who created the first fine



Branley Allan Branson

A trundle bed is a low bed on wheels that can be stored under a larger bed. Such beds were popular in the 1800's.

Nelson Gallery-Atkins Museum, Kansas City, Mo., Nelson Fund

A Chinese bed of the 1400's rests on a low platform and includes drapes, a canopy, and carved wooden railings.

furniture, slept on low wooden couches with legs shaped like animals. Some couches were covered with gold, ivory, or paint. Instead of pillows, the Egyptians used curved, wooden headrests. Ancient Greek and Roman beds resembled Egyptian couches. Because the Greeks reclined while they ate, couches were used for dining as well as sleeping. However, for thousands of years, the most common type of bed was the *pallet,* which was a mattress laid on the floor and filled with straw, reeds, wool, or feathers. The quality of the filling depended on the wealth of the owner.

During the Middle Ages, few European houses had a separate room for sleeping. Instead, all members of the household slept on pallets arranged around the central fireplace of a common room. Only royalty and wealthy people had bedsteads. These bedsteads generally consisted of large timber rails that were supported by heavy square posts. Most beds were placed against a wall or in a corner. Curtains or sliding wooden panels surrounded the bed to provide warmth and privacy.

By the late 1400's, tall, sometimes intricately carved posts had been added to the rectangular frame to support the canopy and curtains. During the next 200 years, beds became free-standing structures. They also became larger and more grandly ornamented. Elaborately decorated beds of the nobility and the wealthy, called *state beds,* were hung with velvet, silk, and other luxurious fabrics. Such beds frequently became the most expensive piece of furniture in a household. During the 1600's, beds first became fairly common in middle-class homes. The frames were light with carved wooden posts. Bedding continued to be costly. Some beds of this time had a *trundle bed,* a low bed on wheels that could be rolled under the main bed.

Beds of the 1700's and 1800's generally took on a simpler, more graceful appearance. Canopies and hangings became especially elaborate. With the exception of the water bed, there were few changes in bed design during the 1900's. Nancy E. Richards

See also **Colonial life in America** (Furnishings); **Furniture** (pictures).

Bed bug is a small, wingless insect that feeds on blood. It lives near the sleeping quarters of its victims. The bed bug attacks people, as well as birds and other animals. It pierces the skin of its victim, and then uses its sharp beak to suck up the blood. Its bite causes the skin of some people to swell and itch.

The bed bug is reddish-brown and about $\frac{1}{4}$ inch (6 millimeters) long when full-grown. Its small size and its oval, flat shape enable it to hide in tiny cracks and crevices. Bed bugs usually hide in the day and hunt for food at night. They may hide in mattresses and bedsprings, between floorboards, or in cracks in plaster. Bed bugs may crawl from house to house, or they may be moved on clothing or furniture.

The adult bed bug lays its eggs in cracks and crevices. It may lay from 100 to 250 eggs. The egg hatches in about one or two weeks, but the young bed bug does not become a full-grown adult for about two months. A bed bug develops more slowly in cold weather than in warm weather. Under ideal conditions, bed bugs may live about one year. They are known to survive without feeding for several months during cool weather.

Bed bugs can become serious pests to people and small animals because of their irritating bites. Some scientists think they may even spread certain diseases. The insects can be controlled by spraying their hiding places

WORLD BOOK illustration by Shirley Hooper, Oxford Illustrators Limited

A bed bug *molts* (sheds its outer layer of skin) five times before maturity. This bed bug is shown before the first molt, *left;* just after the first molt, in the second larval stage, *center;* and after eating, during the second larval stage, *right.*

thoroughly with an effective *insecticide* (insect-killer). Some people *fumigate* their homes (use smoke fumes or special insecticide fumes) to kill or drive out bed bugs. Cyanide gas is probably the most effective fumigating agent used against bed bugs. Candace Martinson

Scientific classification. Bed bugs belong to the order Hemiptera and the bed bug family, Cimicidae. The common bed bug is *Cimex lectularius.*

Bede, *beed,* **Saint** (673?-735), also known as The Venerable Bede, was an English historian and *theologian* (person who studies God and religion). His name is also spelled *Baeda* (pronounced *BEE duh).*

Bede was born in northeastern England. At age 7, he entered the monastery of Wearmouth for his education. He continued his studies at the nearby monastery of Jarrow, where he stayed for the rest of his life as a monk.

Bede's writings covered many subjects, including grammar, spelling, astronomy, and the Bible. He also wrote biographies of saints. Scholars consider Bede's *Ecclesiastical History of the English People* (731) one of the finest historical works of the early Middle Ages. It is the main source of English history up to that time, and it earned Bede the title *The Father of English History.* Bede's *History* tells mainly of the conversion of the English to Christianity, and it includes many colorful tales. Bede was familiar with the writings of such earlier theologians as Saints Ambrose, Augustine, Gregory I (Gregory the Great), and Jerome. Bede was *canonized* (declared a saint) in 1899. Deborah Mauskopf Deliyannis

Bedford, Gunning, Jr. (1747-1812), a lawyer and statesman from Delaware, was a signer of the Constitution of the United States. At the Constitutional Convention of 1787, Bedford spoke out forcefully for the rights of small states, such as Delaware. He served on the committee that drafted a critical compromise on state representation in the national legislature. This proposal, calling for equal representation in the Senate and representation based on population in the House of Representatives, became known as the Great Compromise. Bedford also was a member of the Delaware state convention that *ratified* (approved) the Constitution.

Bedford was born in Philadelphia. He graduated from the College of New Jersey in 1771. Bedford served in the Continental Army during the Revolutionary War in America (1775-1783). About 1779, he began practicing law in Dover, Delaware. He served as Delaware's attorney general from 1784 to 1789. He also represented the state in the Congress of the Confederation from 1783 to 1785. President George Washington appointed Bedford judge of the U.S. District Court for Delaware in 1789. He held that position until his death. Barbara E. Benson

Bedlington terrier is a dog that looks somewhat like a lamb. It has a soft, fleecy coat, and the fur on its head is often trimmed so that its face looks like a sheep's face. The Bedlington has long legs and a slender body. For dog shows, the American Kennel Club requires Bedlingtons to weigh from 17 to 23 pounds (7.7 to 10 kilograms). Its coat is bluish-white or reddish-brown and may have tan marks. The dog is named for Bedlington, England. It came from Bedlington in 1825. Originally, it was raised to fight badgers. It is related to the otter hound and whippet. See also **Dog** (picture: Terriers).

Critically reviewed by the American Kennel Club

Bedloe's Island. See Liberty Island.

Bedouins, *BEHD u ihnz,* are Arab people who traditionally have been nomadic herders in the deserts of the Middle East. Almost all of the approximately 1 million Bedouins are Muslims and speak some form of the Arabic language.

The Bedouins who follow their traditional way of life travel the deserts seeking fresh water and pastureland for their camels, goats, and sheep. They live in tents and wear clothing made from the skin and hair of their animals. The Bedouins eat mostly dairy products, dates, and rice. They trade meat and dairy products from their livestock to people in nearby villages for knives, pots, and other manufactured goods.

The Bedouins are proud and extremely independent. They live by a moral code that emphasizes such values as courage, generosity, and tribal loyalty. Insults to their pride sometimes lead to bloody feuds between tribes.

Since the mid-1900's, increasing numbers of Bedouins have abandoned their traditional nomadic life. They seek such modern advantages as better health care, education for their children, and jobs with higher incomes. The Bedouins have fewer people with whom to trade because many villagers have moved to urban areas.

Most nations in the Middle East have set up programs to encourage Bedouin settlement. For example, some governments give them land on which they can farm and raise livestock, and others build housing projects for them. Kamel S. Abu Jaber

See also **Egypt** (People); **Saudi Arabia** (Rural life).

Bedsore is an *ulcer* (open sore) in the skin caused by prolonged and excessive pressure. Bedsores are also called pressure sores or decubitus ulcers. They occur primarily among elderly, malnourished, and paralyzed people. They can develop on any part of the body but occur mostly over bony areas, such as the hips, spine, and heels.

Bedsores develop after prolonged, constant pressure causes the collapse of blood vessels in an area of the skin. The area no longer receives enough blood, which carries oxygen, and the tissues begin to die from lack of oxygen. The skin turns red and cracks, and an ulcer eventually forms. Bedsores often become infected.

Bedsores can be prevented by good nursing care. This includes frequent changing of the patient's position and the use of skin lubricants to avoid friction and excessive drying. The skin must be kept clean. Bed sores also can be avoided by using a water or gel-filled mattress that distributes the body weight evenly, with special padding under bony areas. Treatment includes keeping the sores clean, dry, and free from pressure.

Charles J. McDonald

See also **Ulcer.**

Bedstraw is one of a group of plants that were once used for mattresses. They are slender herbs with square stems. Their leaves grow in *whorls* (circles) of four to eight at each joint of the stem. The tiny white or brownish flowers have three or four petals. The seed pod, often bristly, has two ball-shaped sections that split apart when ripe. Each section contains one seed.

Bedstraws grow wild in woods and marshes. They are often cultivated in gardens and used in bouquets because of their delicate appearance. Melinda F. Denton

Scientific classification. Bedstraws belong to the madder family, Rubiaceae. They are classified in the genus *Galium.*

Ron Larsen, Van Cleve Photography

A honey bee worker hovers over a flower, sucking up nectar with its tongue. These bees also gather pollen, which they carry in areas called *baskets* on their hind legs.

Bee

Bee is an insect that lives in almost every part of the world except near the North and South poles. Bees are one of the most useful of all insects. They produce honey, which people use as food; and beeswax, which is used in such products as adhesives, candles, and cosmetics. There are about 20,000 *species* (kinds) of bees. Only the kinds known as *honey bees* make honey and wax in large enough amounts to be used by people.

Flowers provide food for bees. The bees collect tiny grains of pollen and a sweet liquid called nectar from the blossoms they visit. They make honey from the nectar, and use both honey and pollen as food. During their food-gathering flights, bees spread pollen from one flower to another, thus *pollinating* (fertilizing) the plants they visit. This enables the plants to reproduce. Numerous wild plants and such important food crops as fruits and vegetables depend on bees for fertilization.

Bees probably developed from wasplike ancestors that first got their food by eating other insects. These creatures gradually switched to flowers as their food source. In time, bees became completely dependent on flowers for food. The flowers, in turn, benefited from the bees. Scientists believe that over the years, bees helped create the wide variety of flowers in the world today by spreading pollen among various plants.

Like most insects, bees have three pairs of legs and four wings. They also have a special stomach, called a *honey stomach*, in which they carry nectar. All female bees have a sting, which they use for self-defense.

Bees can be grouped into two general categories. Most are *solitary bees*. That is, they live alone. Honey bees and bumble bees are examples of *social bees* that live and work together in large groups, or *colonies*.

WORLD BOOK illustrations by James Teason

Worker Queen Drone

Three kinds of bees make up a honey bee colony. The colony consists of thousands of workers, one queen, and a few hundred drones.

E. R. Degginger

Workers store nectar and pollen in some cells of the honeycomb. Other cells hold eggs and developing bees. One square inch (6.5 square centimeters) of honeycomb has about 25 cells.

The honey bee colony

A typical honey bee colony is made up of one *queen,* tens of thousands of *workers,* and a few hundred *drones.* The queen is the female honey bee that lays eggs. The workers are the unmated female offspring of the queen. The drones are the male offspring.

Honey bees live in hives. The hive is a storage space, such as a hollow tree or a box, which contains a *honeycomb.* The honeycomb is a mass of six-sided compartments called *cells.* Worker bees build the honeycomb of wax produced by their bodies. They also collect a sticky substance called *propolis,* or *bee glue,* from certain kinds of trees. They use it to repair cracks in the hive.

The honeycomb is used to raise young bees and to store food. The queen bee lays one egg in each cell in part of the honeycomb. In general, the cells containing the eggs and developing bees are in the center of the hive. This area is called the *brood nest.* The bees store pollen and honey in cells above and around the brood nest. The same cells may be used for different purposes. During spring and summer, many cells are used to raise young bees. In fall, brood production stops, and more cells are available for storing honey through the winter.

The contents of the hive are a prized source of food for many animals, including bees from other colonies. Several workers always guard the entrance to the hive. The bees in each hive have their own special odor. The guard bees can detect bees from other hives by their smell. The guard bees attack strangers, whether they are bees from outside the colony, bears, or human beings. When the threat to the hive is great, such as a bear that jars the hive, the guard bees give off a special *pheromone* (chemical substance). The scent of this pheromone, which smells like bananas, alerts other bees in the hive to come to the aid of the guards.

The body of the honey bee

The honey bee, like all insects, has a body that is divided into three sections: the head, the *thorax* (chest), and the abdomen. The insect's *honey stomach,* in which it carries nectar, is located in the abdomen. The bee's body is thickly covered with fine structures called *hairs.* Bee hair is not true hair, which grows only on mammals, but it resembles true hair. When a bee travels from flower to flower, grains of pollen stick to these hairs. Honey bees range in color from black to shades of light brown. Drones are slightly larger than workers, and queens are longer than both workers and drones.

Eyes. A bee has five eyes—three small ones that form a triangle on top of its head, and a large *compound eye* on each side of its head. Each compound eye has thousands of lenses crowded closely together. Bees cannot focus their eyes because they have no pupils.

Honey bees were the first insects known to be able to distinguish colors. Bees have three kinds of color-sensitive cells in their eyes. These visual cells are especially sensitive to blue, yellow, and ultraviolet rays, which humans cannot see. However, bees cannot distinguish red. To them it blends in with green. In addition to color, bees can distinguish different geometrical patterns, such as those of different kinds of flowers.

Antennae are slender, jointed feelers attached to the front of the bee's head. They have tiny sense organs that provide a means of smelling. Tiny hairs on the antennae probably serve as organs of touch.

Mouth. The bee uses its tongue to suck water, nectar, and honey into its mouth. The tongue is a flexible tube on the outside of the bee's head. It can be shortened, lengthened, and moved in all directions. On the sides of the tongue are two jaws. The bee uses its jaws as tools to grasp wax and pollen.

Strong muscles are attached to the inside walls of the mouth. A bee sucks nectar up its tongue, through its mouth, and into its honey stomach. It can also reverse this process and bring food from its stomach out through its mouth. In this way, workers put nectar into wax cells or give it to other bees.

Wings. A bee has two thin wings on each side of its thorax. The two front wings are larger than the hind wings. When the bee flies, the front wings and the smaller hind wings become fastened together by a row of tiny hooks along the edge of the front wings.

The wings can move up and down, and forward and backward. A bee can fly forward, sideways, or backward, and can hover in one place in the air.

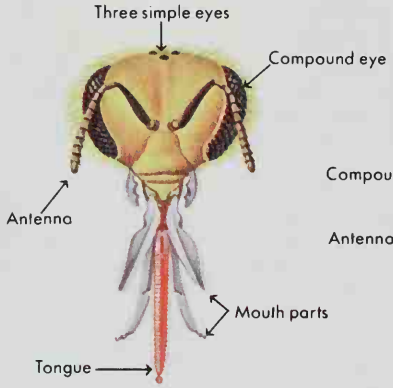
Legs. A bee has three legs on each side of its thorax. Each leg has five main joints, plus tiny segments that make up the foot. The worker bee uses its legs for walking, for brushing pollen off its body, and for handling wax. It carries pollen and propolis on its hind legs.

Each front leg has a notched structure called the *antenna cleaner.* The bee uses it to clean dirt from its antennae. On the outside of each of the hind legs of worker bees is a smooth area surrounded by long,

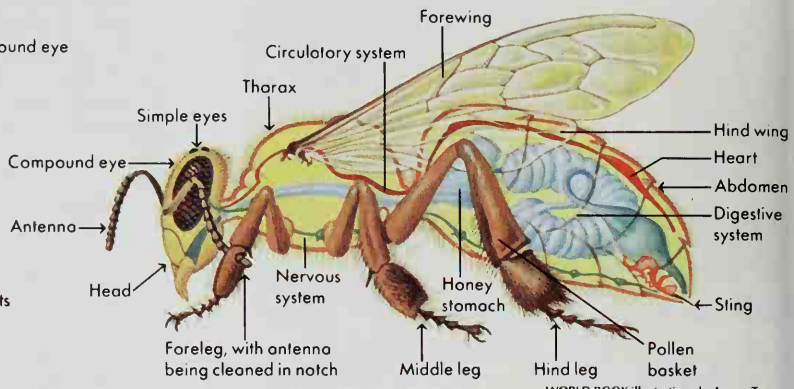
Interesting facts about bees

Fossil bees found in amber probably lived 80 million years ago.
The largest bee is *Chalicodoma pluto,* a mason bee about 1 $\frac{1}{4}$ inches (3.8 centimeters) long.
Size of a bee colony. A strong, healthy colony may contain between 50,000 and 60,000 bees.
The smallest bee is *Trigona minima,* a stingless bee only $\frac{1}{12}$ inch (2 millimeters) long.
Speed. Worker bees fly about 15 miles (24 kilometers) per hour.
Taste. Honey bees can identify a flavor as sweet, sour, salty, or bitter.
A worker honey bee collects enough nectar in its lifetime to make about $\frac{1}{10}$ pound (45 grams) of honey.

Head of a worker bee



Body of a worker bee



WORLD BOOK illustrations by James Teason

curved hairs. This area, called the *pollen basket,* is used to carry pollen. Hairs on the inside of the hind legs help load pollen into the pollen basket. When the worker returns to the hive, it places its hind legs down into a cell and kicks off the pollen. Another worker uses its head to flatten out the pollen on the bottom of the cell.

Sting. Most bees depend on their stingers, or stings, as their only means of defending their home and their lives. Glands attached to the sting produce a *venom* (poison) made up of complex chemical substances.

The sting of a worker bee is straight, with *barbs* (hooks) on it. When the bee thrusts the sting into flesh, the barbs hold tight, and the stinger pulls out of the bee's body. But muscles inside the sting keep working and force it deep into the wound. At the same time, muscles pump more poison down the sting. A worker bee dies soon after losing its sting.

The queen bee has a smooth, curved sting that she uses only to kill other queens. Queens do not lose their stings as do workers. Drones have no stings.

A bee sting causes sudden pain, and the poison produces continued pain and swelling. A person stung by a bee should scrape the stinger off immediately, being careful not to pinch or squeeze it. This action reduces the amount of poison that enters the wound. Some people are so sensitive to bee stings that they may die from only one sting unless a doctor treats them quickly.

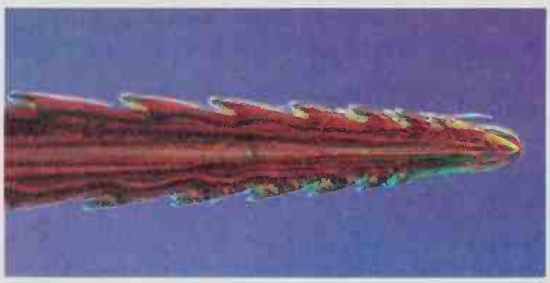
During the 1970's, American scientists became concerned that swarms of vicious South American "killer bees" might spread to the United States. If their hive is disturbed, these bees attack anything that moves. They attack in large numbers, and their stings have killed people and animals. These bees developed in Brazil in the late 1950's and early 1960's. A researcher had imported aggressive African honey bees that produce large amounts of honey. Some of the colonies escaped, and some of their queens mated with local drones. The resulting hybrids have spread rapidly throughout much of South America, Central America, and Mexico.

Swarms of hybrid bees reached Texas in 1990. By the mid-1990's, swarms of these bees had been sighted in several Southwestern States. They are expected to have a serious impact on U.S. beekeeping. Scientists are working to reduce the impact through control of wild populations and management of domestic colonies.

Regulating body temperature. In order to fly, honey bees must maintain their flight muscles at a temperature of at least 86 °F (30 °C). When honey bees are in flight, the heat from the energy they use up is usually enough to keep their flight muscles warm. When honey bees are not flying, they rapidly shiver their wings to stay warm.

Unlike most other insects, honey bees do not hibernate during the winter. Instead, they form a dense cluster in the hive. The clustered bees keep warm by shivering and by crowding together to seal off escaping heat.

Honey bees can also withstand extreme heat inside the hive. In a hot hive, bees crowd less closely together, creating air channels between them. They also gather water and sprinkle it in the hive. As the water evaporates, it cools the hive.



Eric Grave

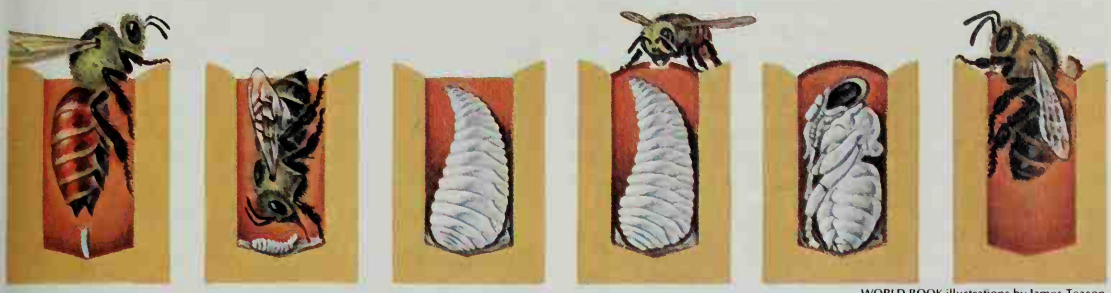
A barbed sting, magnified about 200 times, grows from the end of a worker bee's body. The bee uses it for self-defense.

Life of the honey bee

From egg to adult. Bees develop from eggs laid by the queen. During mating, the drone places *semen* (fertilizing fluid) inside the queen's body. The semen contains *sperm* (male sex cells). The queen stores the sperm in a sac in her abdomen. If the queen releases sperm onto an egg, the egg hatches into a worker. If she does not release sperm, it develops into a drone.

Honey bee eggs are pearly white and about as big as the head of a pin. A bee starts to develop as soon as the queen lays the egg. After three days, a tiny wormlike *larva* crawls out of the egg. The workers place larval food, called *royal jelly,* in the bottom of each cell in the

Stages in the life of a bee



WORLD BOOK illustrations by James Teason

Egg laid by queen | Larva fed by worker | Full-grown bee larva | Larva sealed in its cell | Larva becomes a pupa | Young adult leaves cell

brood nest. Royal jelly is a creamy substance, rich in vitamins and proteins. It is formed by glands in the head of young worker bees. When the larva is three days old, the workers begin feeding it a mixture of honey and pollen called *beebread*.

The workers build a wax cap over the cell about five days after the larva hatches. A great change then takes place. The wormlike larva becomes a pupa. Then the pupa develops into an adult. The adult worker bee bites its way out of the cell about 21 days after the egg is laid. Drones take about 24 days to develop. See **Larva**; **Pupa**.

Growth of the queen. A colony needs a new queen if the old queen disappears or becomes feeble. A new queen is also needed if the old queen and part of the colony decide to leave and build a new hive.

In some unknown way, the workers select a few larvae to become queens. They feed these larvae only royal jelly. At the same time, other workers build special cells for the queens to grow in. A queen cell looks like half a peanut shell hanging from the honeycomb. About $5\frac{1}{2}$ days after hatching, the queen larva becomes a pupa. The queen crawls out of the cell about 16 days after the egg is laid. Scientists believe bees may add a special substance to the queen's royal jelly to make her grow faster and have a different appearance from the workers.

Mating flight. When the young queen emerges from her special cell, the bees in the colony pay little attention to her. She eats honey and gains strength. If two queens hatch at the same time, they fight until one stings the other to death. The old queen may leave the colony, or she may fight with the young queen. After the young queen has killed her rivals, she flies from the

Hive life in spring and summer

Bees perform a variety of jobs in warm weather. Nurse bees, *left,* clean the empty cells and care for the larvae. The queen, *center,* lays eggs, one in a cell. Workers defend the hive by stinging an invading wasp to death, *bottom center.* Field workers, *right,* return to the hive loaded with nectar and pollen. Bees at the entrance to the hive fan in fresh air with their wings, *bottom right.*

WORLD BOOK illustration by James Teason

hive. She may mate with one or sometimes several drones. The young queen then returns to the hive and begins to lay eggs two or three days later. After mating, the queen can lay eggs for the rest of her life. A queen may live as long as five years and produce up to a million eggs during her lifetime.

Swarming. When a colony becomes overcrowded, the queen's egg-laying power diminishes. The workers then build cells for new queens. In these cells, the old queen deposits eggs. After these eggs develop into pupae, the workers cover the cells with wax. A few days after the new queen cells are covered over with wax, many of the workers and the old queen leave the hive as a swarm. Their flight to form a new colony is called *swarming*. Some workers stay behind in the hive and care for the larvae and the new queen.

The swarm clusters around a branch or a post after leaving the hive. Workers called *scouts* then seek out a location for the new colony. Each scout returns to the swarm and uses a special "dance" to indicate the distance and direction of the site it has found to the other scouts. The scouts then investigate one another's sites. At a signal, the entire swarm travels to whichever site seems best. "Streaker" bees who know where the hive is lead the way. The queen follows.

Finding food. Flowers provide bees with the pollen and nectar they use as food. Pollen is the young bees' source of important fats, proteins, vitamins, and minerals. The sugar in nectar is mainly a source of energy.

Scout bees search for food for the hive. When the scouts find food, they return to the hive and use a dance to tell the other bees where the food is in relation to the sun. The dance is similar to the one scout bees use to indicate the location of a new hive.

If the food is located toward the sun, the scout makes a series of rapid runs in a modified figure-8 pattern up the honeycomb. If the food is located 30° to the right of the sun, the scout makes a series of runs 30° to the right of an imaginary vertical line on the honeycomb. The dance also indicates the distance of the food. The faster the scout dances, the closer the food.

Making honey. Flowers often have special glands, called *nectaries,* that produce nectar. Worker honey bees suck up nectar from the flowers with their long tongues and store it in their honey stomachs. In the stomach, a process called *inversion* breaks down the sugar in the nectar into two simple sugars, *fructose* and *glucose*. When the worker bee returns to the hive, it *regurgitates* (spits up) the nectar back through its mouth. It either gives the nectar to other bees or puts it in an empty cell in the hive. As the water in the nectar evaporates, the nectar changes into honey.

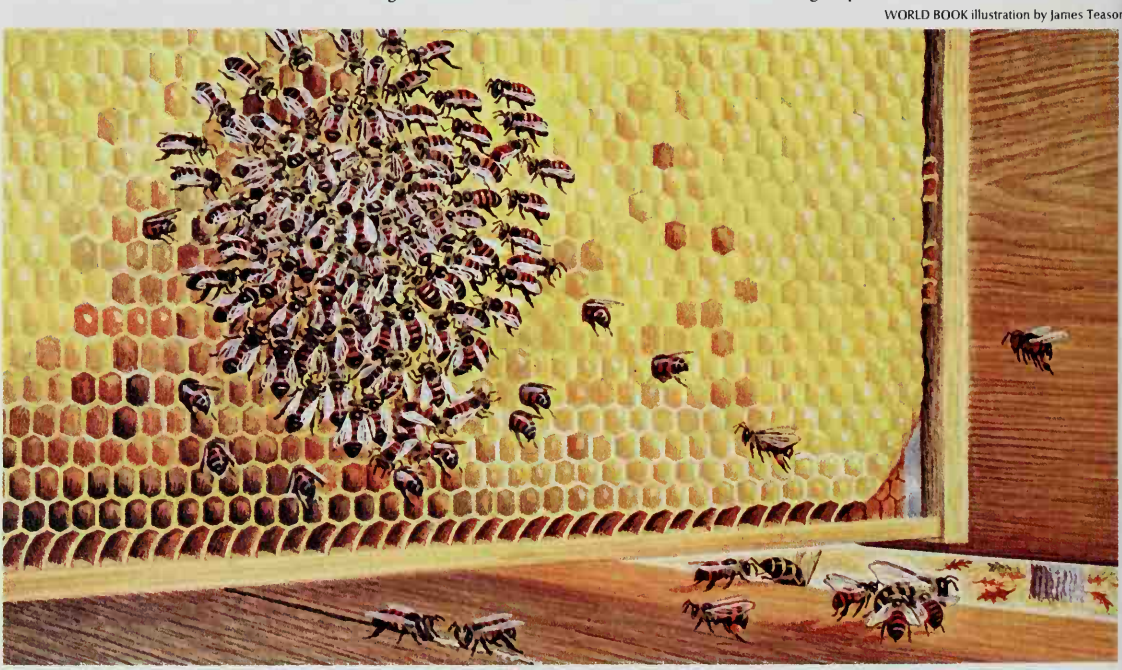
Workers then put wax caps on the honey-filled cells. Beekeepers collect honey from the combs. But they leave enough in the hive to feed the bees. See **Honey**.

Making wax. Special wax-producing glands develop in the abdomens of workers who are about 10 days old. The workers eat large amounts of honey, and the glands convert the sugar in the honey to wax. The wax oozes through small *pores* (holes) in the body and forms tiny white flakes on the outside of the abdomen. A bee usually makes eight flakes at a time. The bee picks them off its abdomen with its legs and moves them up to its jaws. After chewing the wax, the bee puts the wax on the part

Hive life in fall

As cold weather sets in, the queen and workers cluster together on the honeycomb for warmth. They feed on honey that the colony stored up during the spring and summer. In this picture, the bees have already eaten the honey that had been stored in some of the cells, *bottom left.* Some workers, *right,* collect food out of full cells. Others, *bottom right,* push the drones out of the hive.

WORLD BOOK illustration by James Teason



Glen Sherwood

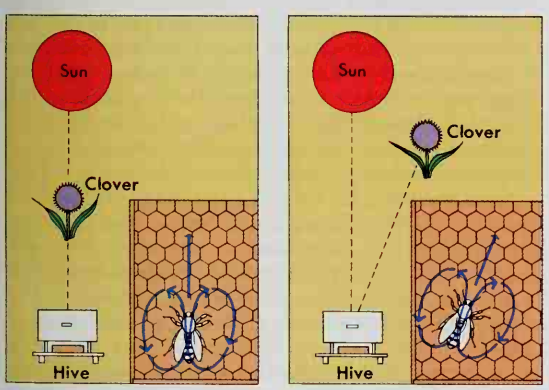
A bee swarm may include thousands of bees. They crowd around a branch while scouts search for a site for a new hive.

of the honeycomb that it is building. The bee produces beeswax only when it needs the wax to build a honeycomb. In general, a worker makes wax from the 10th to 16th day of its life. See **Beeswax.**

Division of labor. Laying eggs is the queen's only job. In the spring, the queen may lay as many as 2,000 eggs a day—about one every 43 seconds.

The only function of drones is to mate with queens. Honey bee drones usually do not mate with the queen of the hive in which they live. They may fly miles away to mate with queens from other hives. Drones are present in the colony only during the summer. They depend on workers to feed them because their tongues are not long enough to obtain nectar. In the fall, when food becomes scarce, the workers stop feeding the drones and drag them out of the hive to die.

Workers do not lay eggs and do not mate. They perform a variety of other jobs, however. For the first three days of its adult life, a worker cleans the hive. It spends the next several days feeding developing honey bees.



WORLD BOOK diagram

Locating food. A worker bee called a *scout* dances a figure-8 pattern up the honeycomb to show the location of the distant nectar. The more rapidly the bee dances, the nearer the food is located. The imaginary line between the loops of the 8 indicates the position of the nectar in relation to the sun.

Then the worker begins to produce wax and to build honeycomb cells. After building the honeycombs, the worker stands guard at the hive entrance and receives nectar collected by other bees. Finally, when a worker is about three weeks old, it begins to hunt for food. It continues this job for the rest of its life. During the busy summer months, a worker may live for only about six weeks. During the less active months of fall and winter, a worker may live up to several months.

Enemies. Bees have many enemies. Bears, Argentine ants, and other animals may destroy the hive in their search for honey. Skunks and dragonflies often eat bees. The wax moth may ruin a weak colony by eating the wax in the honeycomb. Worker bees try to protect the colony by stinging invaders to death, but they do not always succeed. An insect called the *bee assassin* makes a specialty of feeding on bees that it catches in flowers. In much of the world, tiny parasites called *honey bee mites* attack developing honey bees. These mites have destroyed thousands of hives in Asia, Europe, and North and South America.

Both young and adult bees sometimes fall victim to such diseases as European foulbrood and American foulbrood. These diseases may turn the bees into a gummy, lifeless mass. Human activities also harm bees. Insecticides meant to kill other insects kill thousands of bees each year. Weed sprays take away an important source of bee food by killing weeds and their flowers.

Kinds of bees

There are approximately 20,000 species of bees. They can be divided into two main groups—*social bees* and *solitary bees.* Social bees live in colonies, while solitary bees live alone. Most kinds of bees are solitary.

Social bees live in colonies that have as few as 10 or as many as 80,000 members. Honey bees seem to have the most highly developed societies. Stingless bees and bumble bees follow honey bees in social development.

Stingless bees have small stings but do not use them as weapons. They prefer to bite with their jaws. Stingless bees live only in tropical and near-tropical areas. They are not found in the United States.

The largest kind of stingless bee is about as big as a honey bee, and the smallest is about the size of a mosquito. Stingless bees build nests in trees, on walls, in crude hives, or in open areas. They usually build their honeycombs in horizontal layers. An outer wall surrounds the nest except for a small entrance. Colonies may have from 50 to tens of thousands of bees.

Some of the larger stingless bees store honey. South American Indians have long used this honey for food.

Bumble bees live in colonies of 50 to several hundred bees. Their honey has a pleasant flavor, but their nests contain only small amounts. See **Bumble bee.**

Solitary bees live alone. But sometimes thousands of solitary bees gather in a small area and build their nests close together. There are no workers among the solitary bees. Each female is like a queen that does her own work. She builds her own nest and stores pollen and nectar in it. Then she lays an egg on the pollen in each of the cells, seals the nest, and flies away. When the eggs hatch, the larvae eat the stored food. The most important kinds of solitary bees are the carpenter, leaf-cutting, miner, mason, and cuckoo bees.

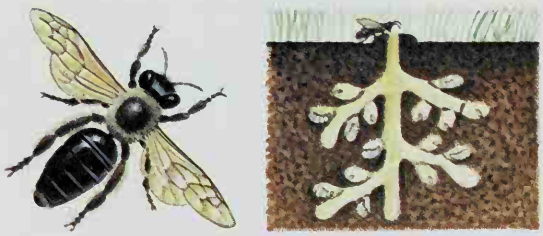
Five kinds of bees

WORLD BOOK illustrations by James Teason

Stingless bees often build their nests in hollow tree trunks. Colonies of these social bees may have from 50 to several thousand members. They live only in tropical and semitropical areas.

The carpenter bee bores a tunnel in wood for its nest. It divides the tunnel into several cells, separated by wood chips mixed with saliva. Each cell contains an egg and some food.

The leafcutting bee also nests in tunnels. It fills the tunnels with cells made of small pieces of leaf mixed with saliva.



The mining bee burrows into loose ground to make its nest. Mining bees are considered solitary insects, but many share the same main tunnel to the surface of the ground.

The mason bee sometimes builds its nest on a stone wall. The nest consists of several cells made of clay and saliva.

Carpenter bees build their nests in dead twigs or branches. The female digs a tunnel, puts pollen and nectar at the bottom, and lays an egg. She spreads tiny wood chips cemented together with saliva across the top of the cell. This ceiling acts as a floor for the cell above. The tunnel has a series of cells, each containing food and one egg.

Leafcutting bees cut out pieces of leaves and pack them into small nests in tunnels. They lay eggs on food which they put into the nests. They may build their tunnels in the ground, in branches, or in pieces of soft wood. A tunnel may have six or more cells, one above the other.

Mining bees usually dig tunnels in the ground. Some kinds show the beginnings of social living. After a few bees dig out a main tunnel, each female digs a short tunnel in the side walls. She provides this tunnel with pollen and nectar, and lays an egg on the food. Some kinds of mining bees post a guard at the entrance to the main tunnel. This guard bee attacks any strangers.

Mason bees sometimes build their nests in decaying wood or in snail shells. One kind strengthens the snail shell with its saliva and small bits of stone. The female puts food in the shell, lays an egg, and covers the whole nest with dried grass, twigs, or pine needles. Another kind of mason bee builds its nest on a wall or large stone. It gathers clay, moistens it with saliva, and forms cells that stick out from the wall. The female provides the cells with food and lays an egg in each. Then she covers the group of cells with a mixture of clay and saliva. The clay hardens and protects the eggs.

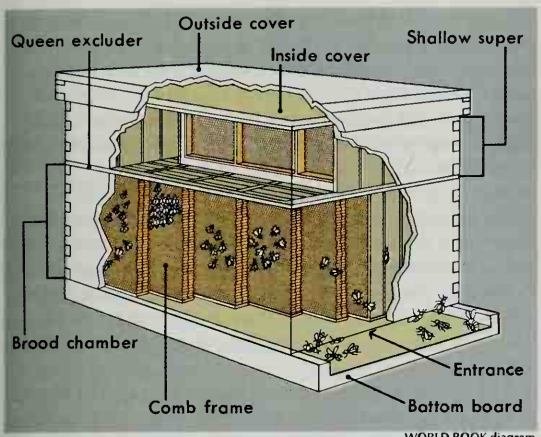
Cuckoo bees do not build their own nests. They cannot provide food for their young, because they have no pollen baskets on their hind legs. Some kinds of cuckoo bees lay their eggs in the nests of other solitary bees. The cuckoo bee larvae usually emerge first and eat the food before the other larvae hatch.

Beekeeping

The people of the Stone Age, thousands of years ago, ate honey that they stole from the hives of wild bees. Some of these people learned to make crude hives for the bees, so the honey would be near their homes. They probably made these first beehives out of hollow logs, a pot placed on its side, or a basket turned upside down. Later, farmers in Europe built straw *skeps* that looked like upside-down baskets. Colonists probably took honey bees with them from England to Virginia in 1622. By the end of the 1700's, honey bees were fairly common throughout the eastern states. The settlers took honey bees with them as they moved west.

As an industry, beekeeping is most highly developed in the United States, Canada, and Australia. Farmers who keep hives of bees can sell the honey and beeswax. The bees also aid farmers by pollinating many crops. Commercial beekeeping, also called *apiculture,* began in the mid-1800's after the invention of modern hives.

Today, beekeepers in the United States tend about $4\frac{1}{4}$ million hives. They produce about 200 million pounds (90 million kilograms) of honey every year. Bakers buy large amounts of honey to use in crackers, cookies, and other baked goods. The rest is packaged in small containers and sold for cooking and as a sweet spread.



WORLD BOOK diagram

A standard hive has removable drawerlike *supers*. The queen stays in the brood chamber, but workers can pass through the queen excluder to store nectar in the shallow super.

Annan Photo

Beekeepers wear protective veils. Light-colored clothes help provide protection from stings. A few experienced beekeepers handle the bees and honeycombs with their bare hands.

About 4 million pounds (1.8 million kilograms) of beeswax is produced and sold in the United States every year. Beeswax is used in candles, lipsticks, polishes, waterproofing compounds, and other products.

Most beekeepers provide *standard hives* for their bees. The hives are made up of several removable drawerlike *supers* (sections). The bees build their honeycombs inside the supers on movable frames that hang $\frac{3}{8}$ inch (10 millimeters) apart. Bees can pass through this *bee space* to all parts of the hive, and the beekeeper can move the frames about. Generally, each super holds 10 combs or frames, and each comb contains about 8,000 cells.

Some beekeepers keep from 40 to 75 hives in one location. If they have more colonies, they use *out-apiaries* (locations) several miles or kilometers apart. The out-apiaries must be separated so that there are enough plants nearby to supply nectar. A colony can gather up to 15 pounds (6.8 kilograms) of nectar in a day.

Beekeepers must learn to handle their bees carefully so the bees will not sting them. Slow, deliberate movements do not disturb bees as much as quick movements. Beekeepers usually wear veils of wire screen or cloth to protect their faces. They tie their clothing at the wrists and ankles. Most beekeepers wear gloves with fingers and thumbs cut off to allow more delicate handling. A few beekeepers do not wear gloves.

Some beekeepers in the southern United States sell packages containing workers and a queen to honey producers. They usually ship 2 to 3 pounds (0.9 to 1.4 kilograms) of bees in wire-screen packages. Other beekeepers rent hives of bees. Farmers place the hives in or near fields, and the bees pollinate the crops.

As a hobby. Many people are more interested in studying bees and their habits than in gathering honey. They often keep bees in a glass-walled hive, where they can watch workers communicate by dancing, and see the queen laying eggs while workers care for the young.

Bees can be kept in both city and farm areas. People keep hives in backyards or on rooftops. Honey bees are easy to handle, and their honey may be eaten or sold. A beginner must buy bees either as a package of workers and a queen, or as a complete hive. A beginner should have the colony inspected by the state bee inspector to make sure it is free of disease.

Scientific classification. Bees belong to the order Hymenoptera, or membrane-winged insects. They make up the superfamily Apoidea. The order Hymenoptera also includes ants and wasps. Honey bees, bumble bees, and stingless bees are members of the family Apidae. The honey bee is *Apis mellifera*. Leafcutting bees and mason bees belong to the family Megachilidae. Carpenter bees and cuckoo bees are in the family Anthophoridae. Mining bees belong to the family Andrenidae.

Bernd Heinrich

Related articles in *World Book* include:

Beeswax	Honey	Larva	Pollen
Bumble bee	Insect	Nectar	Pupa
Clover	(pictures)		

Outline

I. The honey bee colony
II. The body of the honey bee
- A. Eyes
- B. Antennae
- C. Mouth
- D. Wings
- E. Legs
- F. Sting
- G. Regulating body temperature

III. Life of the honey bee
- A. From egg to adult
- B. Growth of the queen
- C. Mating flight
- D. Swarming
- E. Finding food
- F. Making honey
- G. Making wax
- H. Division of labor
- I. Enemies

IV. Kinds of bees
- A. Social bees
- B. Solitary bees

V. Beekeeping
- A. As an industry
- B. As a hobby

Questions

What function does the bee's *honey stomach* serve?
What is the *queen*? What are *workers*? *Drones*?
What do bees use *propolis* for?
How many eyes does a bee have? On what part of the head are they located?
What animals are enemies of bees?
Why are drones removed from the hive in the fall?
What is the name of the food eaten by bee larvae?
How do bees indicate to one another the location of a new hive site?
How do flowers benefit from bees?
What is *swarming*?

Bee-eater is any member of a family of about 25 species of birds related to kingfishers. They live in southern Europe, Africa, Asia, and Australia. These birds are called *bee-eaters* because they feed chiefly on flying insects, particularly bees and wasps.

Bee-eaters measure from about 6 to 12 inches (15 to 30 centimeters) long. They have slim bodies with long pointed wings and long tails. The bill is long, slender, and slightly curved. Bee-eaters have combinations of blue, green, yellow, and red or reddish-brown feathers.

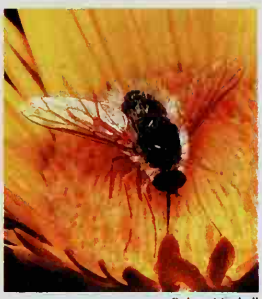
The graceful, swift flight of the bee-eater enables it to capture flying insects. Bee-eaters often circle and glide like swallows while feeding. They also perch on branches, wires, or the backs of grazing animals and dart out after passing insects. Flocks of bee-eaters help control swarms of locusts, which damage crops. But beekeepers view these birds as pests. A single bee-eater can consume several hundred bees a day.

Most bee-eaters inhabit open brushland, plains, reed marshes, or the edge of woodlands. They form flocks of up to several dozen birds. They nest in tunnels, which they dig in sandy river banks or in flat patches of bare ground. The females lay from two to six white eggs.

Scientific classification. Bee-eaters make up the bee-eater family, Meropidae. David M. Niles

See also **Bird** (picture: Birds of Europe and Asia).

Bee fly is an insect that looks like a bee. Most bee flies have short, broad bodies covered with dense hair. They may be black, brown, or yellow. Unlike bees, bee flies have only one pair of flight wings. A pair of small modified wings called *halteres* (pronounced *hal TIHR eez*) are used for balance. Bee flies often rest on or hover above flowers. Their food consists of nectar and pollen. Bee fly larvae eat grasshopper eggs, or larvae and pupae of other insects.



© Robert Mitchell

Bee fly

Scientific classification. Bee flies are in the order Diptera, the true flies. They make up the bee fly family, Bombyliidae.

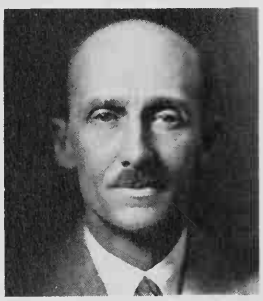
E. W. Cupp

Bee martin. See Kingbird.

Beebe, *BEE bee,* **William** (1877-1962), was a well-known American naturalist and writer. He gained fame for his vivid accounts of tropical jungles, his explorations into the depths of the sea, and his studies of birds, especially pheasants. He became curator of *ornithology* (bird study) at the New York Zoological Society in 1899. He helped found the Society's Tropical Research Department in 1916, and became the director of this department.

Beebe conducted expeditions to Borneo, British Guiana (now Guyana), and Trinidad. His many books include *Jungle Peace* (1918) and *Half Mile Down* (1934), in which he tells of his undersea adventures in an underwater observation device called a *bathysphere.* He also wrote *Beneath Tropic Seas* (1928), *Book of Bays* (1942), and *High Jungle* (1949). Beebe was born in Brooklyn, N.Y.

Carolyn Merchant



Wide World

William Beebe

Beech is a forest tree which grows both in North America and in Europe. Its thin, papery leaves turn gold-colored in the autumn. The twigs are slender and have spear-shaped buds at their tips. The male and female flowers of the beech tree are separate. The male flowers are in globe-shaped heads, the female in short, erect spikes. A bur covers the triangular nut, which is good to eat.

The American beech grows 50 to 75 feet (15 to 23 meters) high. A fungus began attacking beech trees in Nova Scotia about 1900. The fungus spread and now poses a serious threat to beech trees in Quebec and the Northeastern United States.

© Townsend P. Dickinson, Photo Researchers

The American beech has well-balanced spreading branches. Its thin, papery leaves turn a golden color during autumn.

Al Bussewitz, Photo/Nats

Beech trees blossom before their leaves develop fully. They have separate male flowers, *right,* and female flowers. A prickly nut case, *below left,* covers the brown beechnut. The tree's trunk, *below right,* has a smooth bark.

Al Bussewitz, Photo/Nats

Ken Lewis, Animals Animals

Beechwood is hard, close-grained, and tough. It is used to make furniture, tool handles, and veneer. It is a good fuel. The beech family also includes oaks and chestnuts.

Scientific classification. The American beech and the European beech belong to the beech family, Fagaceae. The scientific name for the American beech is *Fagus grandifolia.* The European beech is *F. sylvatica.* Norman L. Christensen, Jr.

See also **Tree** (Familiar broadleaf and needleleaf trees [picture]).

Beecham, *BEE chuhm,* **Sir Thomas** (1879-1961), a British conductor, became one of the world's influential musicians, even though he received little formal musical education. During a period of 40 years, he became a major force in the musical life of Britain. Beecham specialized in opera. He vigorously supported little-known music and founded and financed major orchestras and opera companies. He was known for his irreverent wit and for his expressive flair on the podium.

Beecham was born in Lancashire. At 20, he organized an amateur orchestra. He had achieved world recognition when he made his U.S. debut in 1928 as guest conductor of the New York Philharmonic. He wrote an autobiography, *A Mingled Chime* (1943), and a biography of Frederick Delius (1960). Martin Bernheimer

Beecher, Catharine Esther (1800-1878), an American educational reformer, was an early supporter of education for women. She believed homemaking was the "true profession" for women, and that education should prepare them for it. Beecher organized the scientific study of home economics.

Beecher was born in East Hampton, Long Island, N.Y. She was the eldest child of Lyman Beecher, a famous American clergyman. Catharine attended private school in Litchfield, Conn. In 1823, she established a female seminary in Hartford, Conn., where she pioneered in offering calisthenics for girls. In the early 1830's, Beecher founded a similar school in Cincinnati, Ohio. During the 1840's, she campaigned for more schools and teachers in the Midwest. To promote this need, she founded the American Woman's Educational Association in 1852. Miriam Schneir

Beecher, Henry Ward (1813-1887), the son of Lyman Beecher, was an eloquent, dramatic, and witty Protestant preacher. His sermons were original and timely. In sermons and in the book *Evolution and Religion* (1885), Beecher tried to reconcile the Bible and evolution.

Beecher was born in Litchfield, Conn., and graduated from Amherst College and Lane Seminary. He served as the pastor of the Presbyterian church in Lawrenceburg, Ind., from 1837 to 1839. Between 1839 and 1847, he served a Presbyterian church in Indianapolis. From 1847 until his death, he was pastor of the Congregationalist Plymouth Church in Brooklyn, N.Y. He edited the *Independent* from 1861 to 1863, and the *Christian Union* from 1870 to 1881.

His works include *Seven Lectures to Young Men* (1844), *Star Papers* (1855), *Freedom and War* (1863), *Aids to Prayer* (1864), and a novel, *Norwood* (1867). The first volume of his *Life of Jesus the Christ* was published in 1871. It was completed in 1891 with excerpts from his sermons. Henry Warner Bowden

Beecher, Lyman (1775-1863), was an American clergyman. He became noted for his fiery sermons on temperance, and for opposing Roman Catholicism. Beecher was born in New Haven, Conn. After his ordination in 1799, he became pastor of the Presbyterian church of East Hampton, Long Island, N.Y., and later of Congregational churches in Litchfield, Conn., and Boston.

Beecher was the first president of Lane Seminary (Presbyterian) in Cincinnati from 1832 to 1850. Several of his 13 children became well known. Harriet Beecher Stowe wrote the famous novel *Uncle Tom's Cabin.* Henry Ward Beecher was an eloquent Protestant preacher. Catharine Esther Beecher promoted education for women. Edward, Charles, and Thomas Beecher were all noted Congregational clergymen. Henry Warner Bowden

Beef is the meat obtained from mature cattle. It is one of the chief foods of people in many countries. People in the United States purchase an average of 67 pounds (30 kilograms) of beef per person annually. Only the people of Argentina consume more beef per person. The United States produces the most beef.

In the United States, meat markets and supermarkets sell beef in small cuts, such as steaks and roasts. Beef of good quality has a bright-red color; a trim of white fat; and a smooth, firm texture. Flecks of fat within the meat, called *marbling,* increase the juiciness and tenderness of beef. Some beef is processed and sold as canned beef, cured beef, smoked beef, or dried beef. All of the beef sold over counters has been checked for wholesomeness and for cleanliness by federal or state inspectors.

Grades of beef. The United States Department of Agriculture (USDA) grades beef in addition to inspecting it. Grading of the meat is voluntary and is done at the meat packer's expense independently of inspection. Packers may decide not to have low-quality beef graded, and some packers use their own private grading systems.

From 55 to 60 per cent of the cattle slaughtered receive USDA grades. Department graders judge whole beef carcasses and give them two grades—a *quality grade* and a *yield grade.*

Quality grades indicate the tenderness and tastiness of the beef. Beef is stamped with these grades, which are based chiefly on the age of the animal and the amount of marbling. Beef from young cattle is more tender than that from old animals.

The Department of Agriculture uses eight quality grades: *prime, choice, select, standard, commercial, utility, cutter,* and *canner.* Only the beef of young cattle receives the first four grades. Old cattle supply most of the meat of the other grades.

Restaurants and hotels buy much of the prime beef. Most of the choice, select, and standard beef is bought by supermarkets and meat markets. Commercial, utility, cutter, and canner beef is used chiefly in ground beef or in processed meats, such as bologna and frankfurters.

Yield grades indicate the percentage of marketable beef on a carcass. They give meat packers and sellers an idea of the number of cuts of beef that a carcass will provide. Yield grades are based on several factors, including the amount of outside fat on the carcass and the weight of the carcass immediately after slaughter.

There are five USDA yield grades: *1, 2, 3, 4,* and *5.* A yield grade of 1 shows that a carcass has a large percentage of marketable beef and little fat. A yield grade

Beef cuts and how to cook them

Meat packers slice a beef carcass into *wholesale cuts,* which are sold to supermarkets and then divided into smaller *retail cuts.* This chart shows the various cuts of beef and tells how to cook them.

National Live Stock and Meat Board (WORLD BOOK diagram by James Teason)

Chuck
Braise, cook in liquid.

- Beef for stew (A)
- Ground beef** (A)
- Boneless chuck eye roast* (B)
- Blade roast or steak (B)
- Boneless shoulder pot roast or steak (C)
- Arm pot roast or steak (C)
- Chuck short ribs (C, D)
- Cross rib pot roast (D)

Rib
Roast, broil, panbroil, panfry.

- Rib roast (E)
- Rib steak (E)
- Boneless rib steak (E)
- Rib eye roast (E)
- Rib eye steak (E)

Short Loin
Roast, broil, panbroil, panfry.

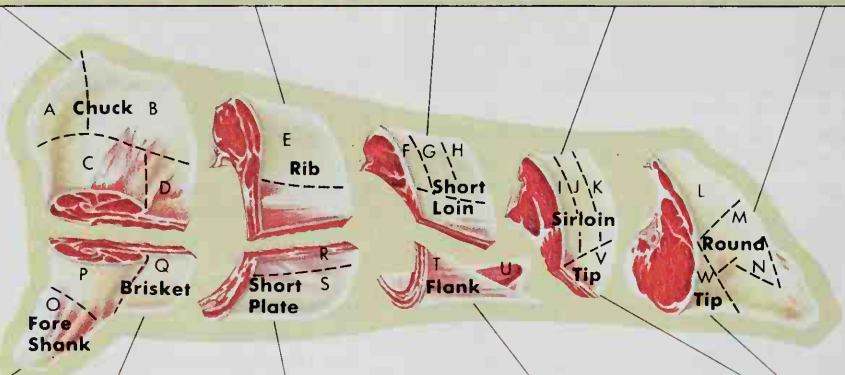
- Top loin steak (F, G, H)
- Boneless top loin steak (F, G, H)
- T-bone steak (G)
- Tenderloin (G, H)
- Porterhouse steak (H)

Sirloin
Broil, panbroil, panfry.

- Pin bone sirloin steak (I)
- Flat bone sirloin steak (J)
- Wedge bone sirloin steak (K)
- Boneless sirloin steak (I, J, K)

Round
Braise, cook in liquid.

- Rolled rump* (L)
- Round steak (M)
- Top round steak* (M)
- Eye of the round (M)
- Bottom round roast or steak* (M)
- Cubed steak* (M)
- Ground beef** (M)
- Heel of round (N)



Fore Shank
Braise, cook in liquid.

- Shank cross cuts (O)
- Beef for stew (P)

Brisket
Braise, cook in liquid.

- Fresh brisket (Q)
- Corned brisket (Q)

Short Plate
Braise, cook in liquid.

- Short ribs (R)
- Skirt steak rolls* (R, S)
- Beef for stew (R, S)
- Ground beef** (R, S)

Flank
Braise, cook in liquid.

- Ground beef** (T)
- Flank steak* (U)
- Beef patties** (T)
- Flank steak rolls* (U)

Tip
Braise.

- Tip steak* (V, W)
- Tip roast* (V, W)
- Tip kabobs* (V, W)

*May be roasted, broiled, panbroiled, or panfried if cut comes from high-quality beef.

**May be roasted, broiled, panbroiled, or panfried.

of 5 means the carcass has a large amount of fat that must be cut off.

Cuts of beef. After a carcass has been graded, meat packers may cut it into sides, quarters, or *primal cuts* to sell to grocers. There are nine primal cuts, which are also called *wholesale cuts.* They are the *round, sirloin, short loin, rib, chuck, fore shank, brisket, short plate,* and *flank.* Divisions of primal cuts are called *subprimal cuts.*

Grocers slice the sides, quarters, primal cuts, and subprimal cuts into smaller pieces called *retail cuts.* Customers buy these cuts as steaks and roasts. Retail cuts from the sirloin, short loin, and rib are considered the most tender and are usually the most expensive.

The primal cuts and retail cuts are shown on the chart with this article.

Food value. Beef contains many *nutrients* (nourishing substances) needed by the human body. It is an important source of protein, a nutrient that helps build and maintain body cells. In addition, beef provides several essential vitamins, including niacin, riboflavin, and thiamine; and such important minerals as iron, zinc, and phosphorus. Beef also has a high energy value. A quarter of a pound (113 grams) of hamburger contains about 265 calories.

Beef also contains fat and a fatty substance called *cholesterol.* Both are needed in the diet. However, many physicians believe that a diet too high in either fat or cholesterol may contribute to the development of certain types of heart disease. They advise some people to reduce their consumption of these substances. But not all doctors agree that a low-fat diet reduces the risk of developing heart disease.

Beef cattle are fed chiefly grass, hay, and other coarse feed called *roughage.* In the United States, cattle raisers have also fed the animals large amounts of grain to fatten them for market and to produce well-marbled beef. However, consumer demand for meat with less fat has led cattle raisers to discover that high-quality beef can be produced from lean cattle. This change in beef cattle feeding practices may make feed grain available for other uses. Joseph G. Sebranek

See also **Cattle; Food supply** (Reducing the demand for feed grain); **Mad cow disease; Meat; Meat packing; Veal.**

Beefly. See **Bee fly.**

Beefwood is a group of trees native mostly to Australia. Beefwoods are also called *casuarinas* and *Australian-pines.* They are narrow trees with drooping branches. The beefwood's tiny, scalelike leaves grow on small, jointed branchlets, giving the branches a feathery look. The entire needlelike branchlet is shed rather than just the leaves. The name *beefwood* refers to the color of the tree's wood, which resembles the color of fresh raw beef.

© Heather Angel, Biofotos

Beefwood

Beefwood trees can grow to about 70 feet (21 meters) in height. They are widely used as windbreaks and as ornamental trees. Beefwood trees grow rapidly and have become an ecological problem in southern Florida, where they have disrupted native plant and animal communities.

Michael J. Baranski

Scientific classification. Beefwood trees are in the casuarina family, Casuarinaceae. They make up the genus *Casuarina.*

Beehive. See **Bee** (Beekeeping).

Beelzebub, *bee EHL zuh buhb,* was the prince of the demons in the New Testament. Jesus identified him with Satan. The ancient Philistines worshiped him under the name of *Baalzebub.* The proper interpretation of his name is not certain. It may be connected with the Assyrian words, *bel-dababi,* meaning *adversary in court,* consequently *an enemy.* In John Milton's *Paradise Lost,* Beelzebub is the fallen angel who ranked next to Satan in power and crime. In English usage, his name is a common word for Satan (see **Devil**). Joseph M. Hallman

Beeper. See **Pager.**

Beer is an alcoholic beverage that is made from cereal grains, hops, water, and yeast. Most beers contain from 2 to 6 per cent alcohol. People throughout the world drink about 30 billion gallons (114 billion liters) of beer annually.

To make beer, brewers mix barley malt with water and such grains as corn and rice. This mixture is heated to convert starches in the grains into sugar and other *carbohydrates* (substances composed of carbon, hydrogen, and oxygen). The grain is removed from the mixture, which is then boiled with hops to provide more flavor. Next, brewers add yeast, which starts a process called *fermentation.* This process changes the sugar into alcohol. After fermentation, the beer is aged for several weeks or months to improve its taste. It is then filtered and packaged. See **Brewing.**

Beer includes such food substances as carbohydrates, proteins, and vitamins and minerals. A 12-ounce (355-milliliter) serving of most beers made in the United States contains from 140 to 150 calories.

The word *beer* is commonly used as the general term for all alcoholic malt beverages. There are two general types of beer—*lager* and *ale*—and they are made by different fermentation processes.

The most popular beer in the United States is lager beer, known for its *effervescence* (bubbly quality) and its balanced hop and malt flavors. *Light beer* is a kind of lager that is specially brewed to reduce the carbohydrates and calories in it. *Pilsner* is also a lager beer, but it has a stronger hops flavor than regular lager. *Dry beer* is a lager that tastes less sweet than other lagers. *Bock beer,* another lager, is a heavy beer with a higher alcoholic content than regular lager. Ale has a distinctive hop flavor and aroma. *Porter* and *stout* are dark ales with a strong and bitter taste. *Malt liquor* is a term for lagers and ales with a higher alcoholic content than regular beers.

Beer is one of the oldest kinds of alcoholic drinks. Beer was brewed at least as early as 4000 B.C. The ancient Assyrians, Babylonians, Chinese, Egyptians, Greeks, Romans, and Teutons all made beer.

August A. Busch III

Beerbohm, Max (1872-1956), was an English comic writer and artist known for his brilliant wit. Beerbohm

became most noted for literary *satires* and *parodies*. A satire uses humor or sarcasm to attack some form of human behavior. A parody is a comic imitation of a literary work. In his art, Beerbohm used *caricature*, a style that ridicules people or objects by exaggerating their physical features.

One of Beerbohm's best-known literary works is *A Christmas Garland* (1912), a collection of parodies of the styles of major writers of his day. His popular novel *Zuleika Dobson* (1911) provides a comic description of student life at Oxford University.

Beerbohm's full name was Henry Maximilian Beerbohm. He was born in London and graduated from Oxford. Beerbohm began his literary career in 1894 by contributing to the *Yellow Book*, an influential magazine. He became a member of London's literary and artistic circle and, in 1898, joined the staff of the *Saturday Review* as drama critic. He succeeded George Bernard Shaw, the British dramatist, as critic for this well-known literary publication. Beerbohm's drama reviews for the *Saturday Review* were collected in *Around Theatres* (1924). King George VI knighted him in 1939, and he became known as Sir Max Beerbohm. Avrom Fleishman

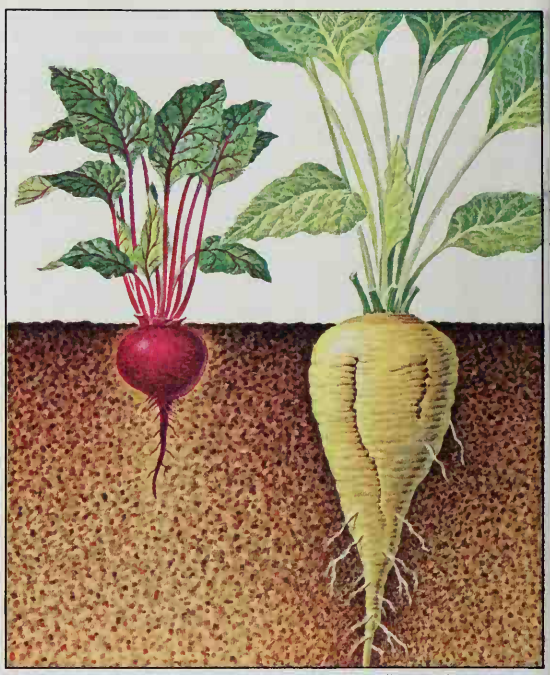
Beers, *beerz,* **Clifford Whittingham** (1876-1943), founded the mental hygiene movement in the United States. He was greatly responsible for changing the care of the mentally ill throughout the world. His brother died of epilepsy in 1900, and Beers himself developed a severe mental illness. He was hospitalized in two private sanatoriums and then in a state hospital. After two years of depression he became rational and decided to reform the care of the mentally ill. He managed to have himself transferred to a ward for violent patients. While in this ward, Beers received brutal treatment.

After his release, Beers wrote his story, *A Mind That Found Itself* (1908). The book described his experiences in the asylums and caused enormous interest. Beers helped found the National Committee for Mental Hygiene in 1909, and the American Foundation for Mental Hygiene, to finance study and research, in 1928. The first International Congress on Mental Hygiene met in 1930 under his leadership. He was born in New Haven, Connecticut, and graduated from Yale. Alan Keith-Lucas

Beersheba, *beer SHEE buh* (pop. 141,400), in Israel, is the place where Abraham settled. It lies on the northern edge of Israel's Negev region (see **Israel** [political map]). It is sometimes called the capital of the Negev. When Israel was established, Beersheba was a small town. Today, it is a bustling city. It is the center of the mining and agricultural projects in the Negev. Bernard Reich

Beeswax is a yellow substance produced by glands on the underside of the abdomen in worker honey bees. The wax oozes from the glands in small scales, and the worker bees pick it off and make honeycombs out of it. Honeycombs are used for storing honey, holding eggs, and growing new bees. People get beeswax from the honeycomb after they have extracted the honey. They melt the comb in boiling water. The wax rises to the surface, and they dip it off. They then melt the beeswax again and filter it to remove impurities. Beeswax is used in such products as adhesives, candles, chewing gum, cosmetics, lubricants, and polishes. See also **Honey; Bee** (Making wax). Bernd Heinrich

Beet is a plant grown for food. There are many varieties of beets. The root of the *table beet* is cooked as a vegetable. The *sugar beet* is also grown for its root, a leading source of sugar. Both varieties are important commercial crops. The *mangel-wurzel* is a large beet grown in Europe. It is used for livestock feed. Beets originally grew wild in the area around the Mediterranean Sea.



WORLD BOOK illustration by James Teason

Beets are grown for their roots and leaves. The fleshy root and the juicy leaves of the table beet, *left*, are good to eat. The root of the sugar beet, *right*, is a major source of sugar.

The thick roots of table beets may be round or pointed and dark red, whitish, or golden-yellow. The roots are usually canned, either whole, sliced, or *diced* (cut in small pieces). They may also be *pickled* by packing them in vinegar or *acetic acid* (an acid found in vinegar). Fresh roots are usually boiled in water for an hour or more before they are eaten. Table beet roots are a low-calorie, low-carbohydrate food containing iron and calcium. The *greens* (leaves) from young plants are an excellent source of calcium, iron, and vitamin A.

The long, pointed root of the sugar beet is creamy-white. Sugar beets provide about half of the sugar produced in the United States and much of that produced in many other parts of the world. Sugar beets are discussed in the *World Book* article on **Sugar beet.** For information on the processing of sugar beets, see **Sugar.**

In the United States, Wisconsin and New York are the leading producers of table beets. Beets are also a common garden vegetable. The seeds should be planted in early spring, about 1 inch (2.5 centimeters) deep in rows from 12 to 15 inches (30 to 38 centimeters) apart. Young plants should be thinned out so they are from 3 to 5 inches (8 to 13 centimeters) apart. W. E. Splittstoesser

Scientific classification. Beets belong to the goosefoot family, Chenopodiaceae. The scientific name for both the table beet and the sugar beet is *Beta vulgaris*.

Granger Collection

Ludwig van Beethoven wrote some of the world's greatest music. He was also recognized as a gifted concert pianist.

Beethoven, *BAY toh vuhn,* **Ludwig van** (1770-1827), was one of the greatest composers in history. His most famous works include the third (*Eroica*), fifth, sixth (*Pastorale*), and ninth symphonies; an opera, *Fidelio;* and his religious composition *Missa solemnis.*

Beethoven has had a great influence on music. He won for composers a new freedom to express themselves. Before his time, composers wrote works for religious services, to teach, and to entertain people at social functions. But people listened to Beethoven's music for its own sake. As a result, he made music more independent of social, religious, or teaching purposes.

Beethoven's life

Beethoven was born in Bonn, Germany, on Dec. 16, 1770. He showed musical talent at an early age and learned to play the violin and piano from his father, Johann. Johann hoped to make Ludwig a gifted child like the famous composer Wolfgang Amadeus Mozart. At the age of 11, Ludwig became assistant to the organist of the local court. From 1788 to 1792, Beethoven played viola in the local theater orchestra.

Beethoven's father developed a severe drinking problem. His mother died in 1787. Beethoven found relief from his difficult family life when he became the tutor of the two children of the von Breuning family. The children's mother was a kind, well-educated woman who introduced Beethoven to important people in Bonn.

Beethoven visited Vienna in 1787. There, he played for Mozart and probably took a few lessons from him. Beethoven also met Count Ferdinand Waldstein, who became his lifelong friend and often helped his career. In 1792, the composer Joseph Haydn, who was in Bonn, praised one of Beethoven's compositions and encouraged him to visit Vienna. The *Elector* (ruler) of Cologne sent Beethoven to Vienna later that year. He was welcomed into the homes of many of Vienna's leading noblemen. Except for short trips, he stayed there the rest of his life.

Many great composers of the day, even Haydn and Mozart, were treated as employees by the people who bought their music. However, Beethoven associated as an equal with royalty and the nobility. They paid him for his works, but they knew and admired him as a friend rather than as an employee.

Beethoven suffered from chronic illnesses throughout his life and began to lose his hearing in the late 1790's. From about 1800, his personality changed. Beethoven had always been proud, independent, and somewhat odd, but he became more suspicious and irritable. In 2000, scientists announced the results of an investigation which suggested that Beethoven's physical and personality problems, though not his loss of hearing, may have been caused by lead poisoning.

Beethoven became totally deaf during the last years of his life. His deafness did not hinder his composing, but it did reduce his normal social life.

Beethoven's life took on added bitterness because of his unhappy relationship with his brothers Johann and Karl. Some scholars blame the two brothers for the trouble, but Beethoven himself was hard to get along with. Karl died in 1815, leaving a 9-year-old son. The boy became Beethoven's ward, but this relationship also turned out badly. Beethoven did not have the disposition to be a father, and the young man rebelled against him, causing Beethoven much grief. Beethoven caught a serious cold at the end of 1826. It developed into pneumonia and then dropsy. He died on March 26, 1827.

Beethoven's music

Beethoven's works for orchestra include nine symphonies, five piano concertos, a violin concerto, and several overtures. His chamber music consists largely of 16 string quartets; 5 string trios; 9 trios for piano, violin, and cello; 10 violin sonatas; and 5 cello sonatas. His piano works include about 35 sonatas, more than 20 sets of *variations* (musical themes repeated with changes), and several smaller pieces. His vocal works consist chiefly of the opera, *Fidelio;* a song cycle, *An die ferne Geliebte,* and many other songs; several short pieces called *cantatas;* and the Mass in C major and the Mass in D major (*Missa solemnis*).

Throughout his life, Beethoven was guided by a basic optimism and a faith in moral values. These always dominated his music, although darker moods and a grim struggle usually preceded the joy typically found at the end of his compositions.

Beethoven's sketchbooks show that he worked out his compositions with great care, tirelessly revising his themes and altering the shapes in which they appeared. This process often went on for many years before he was satisfied with the details and the overall form of his ideas. This painstaking workmanship is evident in the first movement of the fifth symphony and in the Hammerklavier Sonata, Op. 106. Such works show Beethoven's belief in the serious nature of his mission and the immortality of his work—a novel belief at that time.

The first period of Beethoven's composing career extended from the late 1780's to approximately 1800. Beethoven's works during this period also show some dependence on older composers, especially Haydn, Mozart, C. P. E. Bach, and Christian Neefe, one of his teachers in Bonn. These works, nevertheless, show individuality in the careful way they are written and their strong melodies.

The second period, from about 1800 to 1815, was Beethoven's most productive period. He wrote his third through eighth symphonies, the last two piano concertos, his violin concerto, and many chamber pieces. In addition, Beethoven wrote 14 piano sonatas, including the *Moonlight Sonata,* the *Waldstein,* and the *Appassionata.*

Beethoven's music has become familiar on most concert programs today, but early in his own career his works aroused much controversy. He greatly expanded and changed traditional music forms such as the symphony. The force and strength of these works confused some critics, who found many of Beethoven's compositions impossible to understand. In his third symphony, the *Eroica,* he revealed the ideal of heroism that he thought Napoleon symbolized. His audiences could not understand this work at first. However, the power and nobility of Beethoven's music came to be widely recognized and praised before he died.

In *Fidelio,* Beethoven was inspired by the story of a wife's devotion and courage in rescuing her husband from unjust imprisonment. In this opera, Beethoven praised the ideals of freedom, dignity of the individual, and heroism overcoming tyranny—ideals characterizing the French Revolution. *Fidelio* gave Beethoven more trouble than any of his other works. Beethoven revised it twice, and wrote four overtures before he was satisfied. He found himself restricted by the demands of composing for the stage and may have felt that writing operas was unsuited to his talents. *Fidelio* displays dramatic force, but its mood and meaning are expressed more by music than by action.

The third period includes several important works. The *Missa solemnis* is one of the most moving of religious compositions. The ninth symphony glorifies the ideal of human brotherhood that flourished in the late 1700's. In his last piano sonatas and string quartets, Beethoven created a new and personal world of expression. These works carry a feeling of great power and mysterious complexity. Yet Beethoven gave these works a lyrical quality expressed with touching simplicity.

The works of the second period had tremendous influence on the romantic composers of the early 1800's. But the works of the third period were not fully understood until later, partly because they were extremely difficult to perform. In his quartets and sonatas, Beethoven tried to include complicated musical structures and *fugues*—short themes imitated or repeated by different instruments according to strict musical rules. These works demanded entirely new qualities of sound from the string quartet and piano. His compositions of the last period had a vital influence on the composers of the 1900's, notably Arnold Schoenberg and Béla Bartók.

Beethoven's place in music history

Beethoven belongs to both the classical and romantic eras of music history. In his skillful musical *motives* (brief themes), he was a master of classical techniques. Beethoven also explored the new and more mysterious qualities of tone that attracted the romantic composers. Beethoven's music suggests meanings without making them specific.

Because of this constant feeling of hidden significance, Beethoven was regarded in the 1800's as one of the founders of musical romanticism. It became fashionable to invent or "discover" stories that would explain the meaning of his instrumental works. Beethoven set this fashion by attaching descriptive titles such as "Pastoral" to some of his works. The ninth symphony in particular seems to endorse the notion that his instrumental music was striving for some definite meaning, since its final movement uses the words of an ode by the German writer Friedrich Schiller.

To the romantic composers of the first half of the 1800's, this suggestive but indefinite property was the most attractive feature of Beethoven's instrumental music. However, the more realistic composers of the late 1800's regarded this indefinite style as a fault. This style made the realistic composers turn away from sonatas, quartets, and symphonies toward opera and *program* (descriptive) music.

To both romantic and realistic composers, however, Beethoven correctly appeared as the composer who had first realized the full potential of instrumental music. He had sustained large, independent works of art from beginning to end with a convincing and highly varied flow of emotion. Yet the unity of each musical work did not rely on this psychological development or on an external course of action. Such unity always rests on the organization and interrelationships of the music itself. This was the classical and major part of Beethoven's accomplishment. Like Haydn and Mozart, Beethoven expressed emotion without sacrificing formal balance.

Darrell Matthews Berg

See also **Symphony.**

Additional resources

Cooper, Barry. *Beethoven.* Oxford, 2000.
Plantinga, Leon. *Beethoven's Concertos.* Norton, 1999.
Solomon, Maynard. *Beethoven.* Rev. ed. Schirmer Bks., 1998.
Stanley, Glenn, ed. *The Cambridge Companion to Beethoven.* Cambridge, 2000.

Beetle is one of the most common of all insects. There are about 300,000 *species* (kinds) of beetles in the world. They live everywhere on earth except in the oceans. Beetles are found in rain forests and in deserts. They live in freezing cold areas and in hot springs. They also inhabit mountain lakes and can even survive in polluted sewers.

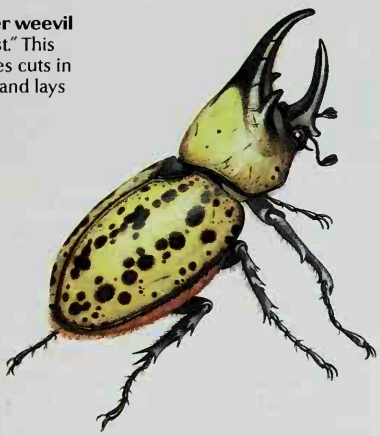
Beetles have typical insect body parts, including antennae, three pairs of legs, and a tough *exoskeleton* (external skeleton). However, unlike other insects, adult beetles have a pair of special front wings called *elytra.* These wings form leathery covers that protect the beetle's body and delicate hind wings. Because of their shell-like skeleton and hard wing covers, beetles have been called the "armored tanks" of the insect world.

Beetles vary greatly in shape, color, and size. Some, such as click beetles and fireflies, are long and slender. Others, including ladybugs, are round. Most beetles are brown, black, or dark red in color. But some have

A female leafroller weevil uses a leaf as a "nest." This type of beetle makes cuts in the leaf, rolls it up, and lays eggs in the folds.

Thomas Eisner

A bombardier beetle, *shown here,* defends itself by squirting a hot, irritating jet of gas at its attacker. It produces this spray by mixing chemicals from two organs located at the end of its body.



WORLD BOOK illustrations by John F. Eggert

A male eastern Hercules beetle, *shown here,* has a long horn. This beetle is also one of the largest beetles in North America. It grows to 2 $\frac{1}{2}$ inches (6 centimeters) long.

Hans Reinhard, Bruce Coleman Inc.

Male stag beetles have long jaws that they use to defend themselves. Stag beetles get their name from the jaws, which resemble the antlers of a *stag* (male deer).

bright, shiny, rainbow colors. The smallest beetles, feather-winged beetles, measure less than $\frac{1}{50}$ inch (0.5 millimeter) long. One of the largest beetles is the Goliath beetle of Africa. It grows about 5 inches (13 centimeters) long and weighs over 1 $\frac{1}{2}$ ounces (42 grams).

Most species of beetles are *solitary insects*—that is, they live alone and have no family life. The young develop without help from their parents. A few species of beetles are *social* insects. These beetles spend at least part of their life in family groups.

Beetles have many enemies, including birds, reptiles, and other insects. Most beetles protect themselves from enemies by hiding or by flying away. A few beetles produce bad-smelling chemicals that discourage attackers. Some beetles can bite.

Many beetles are pests because they feed on farm crops, trees, or stored food. But some beetles are helpful to people. For example, ladybugs and certain other beetles save crops by eating insect pests. Other beetles are important because they eat dead plants and animals and thus remove them from the environment.

The bodies of beetles

Like other insects, beetles have a body that is divided into three main parts. These parts are: (1) the head, (2) the thorax, and (3) the abdomen.

The head includes the beetle's mouthparts, eyes, and a pair of antennae. The eyes and antennae are the insect's chief sense organs.

Mouthparts. Beetles have chewing mouthparts. In beetles called *weevils,* the mouthparts are part of a long snout. A beetle's jaws are called *mandibles.* A number of beetles have large, pincerlike mandibles.

Eyes. Beetles have a *compound eye* on each side of the head. Each eye consists of a bundle of tiny, light-sensitive lenses. Each lens contributes a small bit of the total image that a beetle sees. Most beetles see motion and colors quite well. A few species are blind.

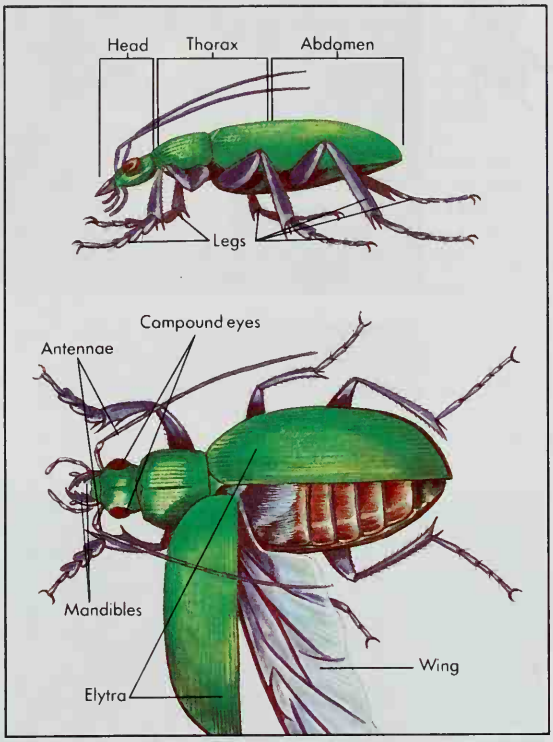
Antennae vary greatly among beetles. Many beetles have antennae made up of threadlike or beadlike segments. In many of these beetles, the tip segments of the antennae are club-shaped. Some beetles have elbow-shaped or featherlike antennae. A beetle's antennae are covered with hairs and special organs that can detect specific odors. Some beetles have special sense organs near the base of the antennae that provide a simple type of hearing. These organs send messages to the brain when certain sounds vibrate the antennae.

The thorax forms the middle of the beetle's body. It consists of three segments, each with a pair of legs. The second and third segments each have a pair of wings.

Legs. Each leg of a beetle has five segments and claws

The external anatomy of a beetle

WORLD BOOK illustrations by John F. Eggert

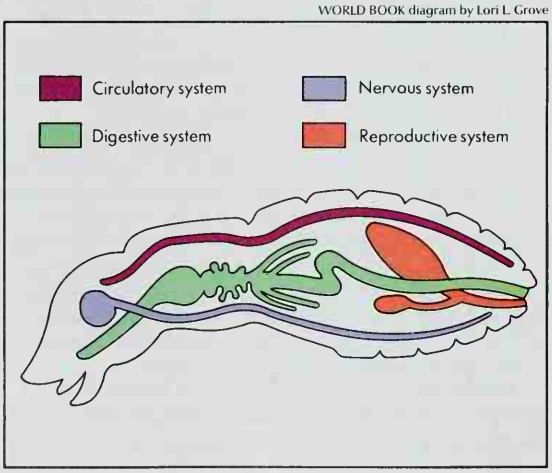


at the end. Most beetles that are fast runners have long, slender legs. Other beetles have short, stout legs, often with flat pads on the bottom. These pads have hundreds of expanded hairs that act like suction cups and enable the beetle to walk upside down on slick surfaces. The legs of digging beetles possess toothlike projections that are used to scrape away soil. Most swimming beetles have flattened hind legs. In some species, these legs are fringed with long hairs to form paddles.

The internal anatomy of a beetle

This diagram gives an internal view of a typical female beetle. Included are features of the reproductive, nervous, circulatory, and digestive systems.

WORLD BOOK diagram by Lori L. Grove



Wings. A beetle's front wings, the elytra, are attached to the second segment of the thorax. The hind wings are attached to the third segment. In most species, the elytra cover the hind wings when the insect is not flying. To fly, a beetle pops open the elytra and holds them upward and outward so it can move its hind wings freely.

The abdomen contains the reproductive organs and the chief organs of digestion. It typically consists of 10 segments, though only 5 to 8 segments may be visible. The segments are usually soft on the upper surface where they are covered by the elytra. The undersurface is harder for protection. Each segment of the abdomen has a pair of tiny holes called *spiracles.* Oxygen enters the beetle's body through the spiracles.

The life cycle of beetles

A beetle passes through four stages of development during its life: (1) egg, (2) larva, (3) pupa, and (4) adult. The beetle changes greatly in appearance and structure from one stage to another. This process of development through several stages is called *metamorphosis.*

The egg. Most female beetles lay eggs with oval shapes and drab colors. A female beetle may lay from a few to several thousand eggs at one time, depending on the species. Most beetles place their eggs on the surface of their food or inside cracks or holes. Eggs laid in the spring or summer may take a week to a month to hatch. Some species lay eggs in the fall. The eggs of these beetles hatch the following spring.

The larva of a beetle is often called a *grub.* This form of the insect looks much different from the adult and may eat different food. Most larvae are wormlike, but some look like tiny lizards. In most species, the larval stage lasts from a few weeks to a few months. The larvae of some June beetles may take five years to mature.

As a beetle larva grows, it completely fills its rigid exoskeleton. It then breaks out of the exoskeleton while forming a new, larger one. This process is known as *molting.* Beetle larvae molt from three to seven or more times, depending on the kind of beetle.

The pupa. When the larva molts for the last time, it transforms into a pupa. The pupa resembles an adult, but it is softer and different in color. In addition, the pupa has only small, padlike wings. Most beetles spend the pupal stage underground. This stage may last from a few days to an entire winter, depending on the species. During this time, adult organs form. When this process is complete, the pupa molts and the adult emerges.

The adult has a short life and so must mate quickly. After mating, the female must find a place to lay her eggs. Most adults live for several weeks or months.

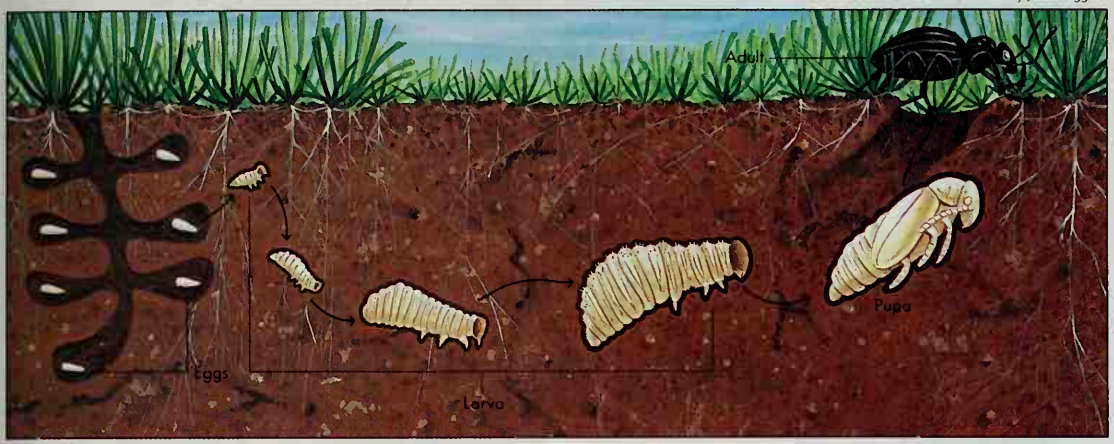
Kinds of beetles

Beetles make up the insect order Coleoptera. *Coleoptera* is a Greek word meaning *sheath wings.* It refers to a beetle's elytra, which form a *sheath* (cover) for much of the upper body. The order Coleoptera is the largest order of insects. Nearly 40 percent of all insect species belong to it. The order is divided into about 150 families. This section describes some of the major beetle families. The scientific name of the family appears in parentheses after the common name.

The life cycle of a beetle

A beetle goes through four stages of development: (1) egg, (2) larva, (3) pupa, and (4) adult. The illustration below shows the development of a broad-nosed beetle. The egg, laid in the ground, hatches into a larva. As the larva grows, it sheds its outer skin several times before becoming a pupa. The adult organs develop in the pupa. When this process is complete, the adult emerges.

WORLD BOOK illustration by John F. Eggert



Weevils (Curculionidae), also called *billbugs* and *snout beetles,* consist of more than 40,000 species. They are the largest family of beetles. The mouthparts of adult weevils are at the tip of a long snout used to bore into fruits, seeds, and other plant parts. The larvae are legless and feed inside fruits and nuts or are borers. Many weevils are serious crop pests. Adults and larvae cause great damage by eating cotton *bolls* (seed pods). Most weevils are brown or gray, but some tropical species are brightly colored. See **Boll weevil; Weevil.**

Leaf beetles (Chrysomelidae) total more than 25,000 species. Most leaf beetles can fly. When disturbed, however, many drop to the ground and play dead. Both the larvae and adults eat leaves and are serious crop pests. The *Colorado potato beetle* is one of the most common pests. It causes much damage to potato crops. See **Potato beetle.**

Ground beetles (Carabidae) number more than 20,000 species. The adults have long legs and long antennae. Most species hide during the day and search for food at night. Both the adults and larvae prey on other animals. Some species of ground beetles have been brought to the United States to prey on crop-eating insect pests. The bombardier beetle is an unusual ground beetle. It defends itself by squirting two chemicals from the end of its body. The chemicals mix to produce a hot puff of gas that can repel an enemy.

Rove beetles (Staphylinidae) make up more than 20,000 species. Rove beetles have unusually short elytra, which make them look like other insects called *earwigs.* Earwigs, however, have sharp pincers at the tip of the abdomen. Some rove beetles turn up the tip of their abdomen as if they could sting. Most larvae and adults prey on other animals or eat dead or decaying materials. Some species live on fungi or mosses.

Scarabs (Scarabaeidae) consist of about 20,000 species. Dung beetles and tumblebugs are scarabs. They feed on *dung* (solid body wastes of animals). They can shape a mass of dung into a ball and bury it in soil. Females lay one egg in the ball of dung. Junebugs and Japanese beetles are two types of scarabs that eat crop plants. See **Japanese beetle; Junebug; Scarab.**

Click beetles (Elateridae) total about 8,000 species. These long, slender beetles jump or make a clicking sound if disturbed. They do this by means of a hooklike part that locks the first and second segments of the thorax. By building up pressure between these two body segments and then releasing the hook, a sudden body jerk and clicking sound is produced. Adult click beetles are commonly attracted to lights at night. Most larvae of click beetles are slender and have hard, ringlike body segments. These larvae are commonly called *wireworms.* The larvae of some species eat the roots and seeds of crop plants. See **Click beetle.**

Predacious diving beetles (Dytiscidae) make up about 4,000 species. They live in bodies of fresh water. They prey on snails, tadpoles, and small fish. The larvae, which also live in the water, have long, soft bodies. The adults swim by moving their hind legs together like oars. When under water, the adults breathe air trapped in their body hairs or beneath their elytra.

Ladybugs (Coccinellidae), also called *ladybirds* and *lady beetles,* number more than 4,000 species. Adult ladybugs have round bodies. Many are red, orange, or yellow and have black spots. The larvae look like miniature lizards and some are brightly colored. Both adults and larvae eat insects that attack trees, shrubs, and fruit and vegetable crops. In the fall, species of ladybugs gather in large numbers to hibernate under leaves at the base of trees, under stones, or in debris. See **Ladybug.**

Fireflies (Lampyridae), also called *lightning bugs,* total about 1,900 species. Most species produce a cool, chemical light in the abdomen through a process called *bioluminescence.* The fireflies produce this light to find one another during mating. Each species uses a special pattern of flashes to identify each other. Some adult fireflies do not feed. Others eat pollen or nectar. The larvae prey on snails and insects. The glowing larvae and the

Some kinds of beetles There are more than 300,000 species of beetles. They live in nearly every type of environment on earth except in the oceans. These drawings and photographs provide examples of the great variety of sizes, shapes, and colors of beetles.

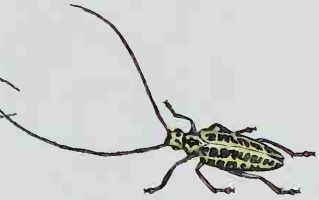
Nine-spotted ladybug

Fiery searcher beetle

Kjell B. Sandved, Bruce Coleman Inc.

Six-spotted green tiger beetles

Block ground beetle



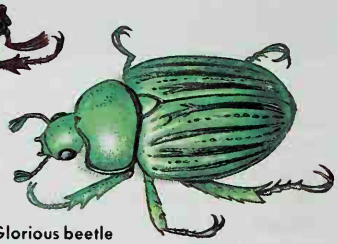
Cottonwood borer

Golden and brown rove beetle

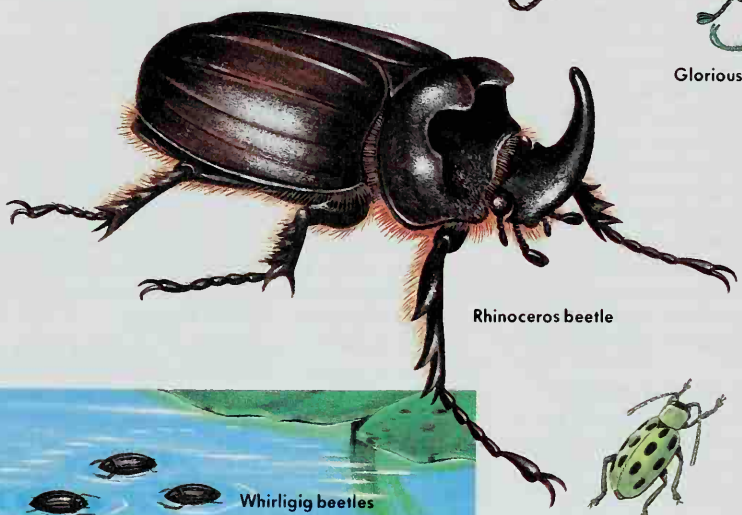
Eyed click beetle

Pennsylvania firefly

Ten-lined June beetle



Glorious beetle



Rhinoceros beetle

Edward S. Ross

Peruvian tortoise beetle

Spotted cucumber beetle

Pototo flea beetle

Asparagus beetle

Large chestnut beetle

Agove weevil

WORLD BOOK illustrations by John F. Eggert

flightless females of some species are often called *glowworms.* David J. Shetlar

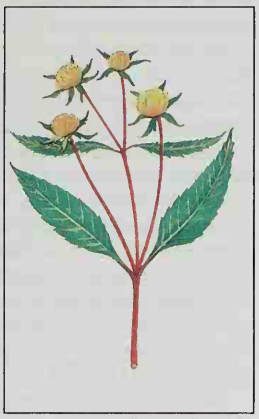
Scientific classification. Beetles make up the order Coleoptera in the class Insecta and the phylum Arthropoda.

Related articles in *World Book* include:

Antennae
Bean beetle
Burying beetle
Carpet beetle
Deathwatch
Earwig
Firefly
Flour beetle
Grain weevil
Hercules beetle
Insect (pictures)
Rose chafer
Spanishfly
Stag beetle
Water beetle

Beetroot is a British term for *beet.* See **Beet.**

Beggar-ticks, also called *stick-tights,* are a type of plant with sticky, flat, seedlike fruits. The fruits or fruit segments have tiny hooks that stick to the fur of animals or to clothing, as do ticks. People and animals scatter the fruits. The *tick trefoil* bears similar sticky fruits and is often referred to as *beggar's-ticks.* Ronald L. Jones



WORLD BOOK illustration by Lorraine Epstein

A beggar-tick

Scientific classification. Beggar-ticks are in the genus *Bidens* in the family Asteraceae, which is also called Compositae. The tick trefoil belongs to the genus *Desmodium* in the pea family, Fabaceae or Leguminosae.

Beggarweed is a branching, rapidly growing plant that reaches a height of about 6 feet (1.8 meters). It bears tiny bluish-purple flowers. Nitrogen-fixing bacteria grow on the plant's roots. Farmers grow beggarweed to help restore fertility to fields. Beggarweed is native to the West Indies. It is cultivated in the southern United States and other warm regions. It sometimes grows as a weed. Ronald L. Jones

Scientific classification. Beggarweed belongs to the pea family, Fabaceae or Leguminosae. It is classified as *Desmodium tortuosum.*

Begin, *BAY guhn,* **Menachem,** *mehn AHK hehm* (1913-1992), served as prime minister of Israel from 1977 to 1983. The leader of the conservative Likud Party, he came to power after the party won a majority of the seats in the *Knesset* (Israeli parliament). After the 1981 elections, the Likud Party and smaller conservative parties formed a coalition, and Begin remained prime minister. Begin resigned from office in 1983.

In 1978, Begin, President Anwar el-Sadat of Egypt, and President Jimmy Carter held discussions in the United States about ways to end the Arab-Israeli conflict. The discussions resulted in a major agreement that included plans for Israel's withdrawal from Egypt's Sinai Peninsula. The agreement also called for a peace treaty between Israel and Egypt. In addition, the agreement provided for Palestinian autonomy in two Israeli-occupied territories—the West Bank, which was formerly ruled by Jordan; and the Gaza Strip, which was formerly administered by Egypt.

William Karel, Sygma

Menachem Begin

Begin and Sadat shared the 1978 Nobel Peace Prize for their efforts to end the Arab-Israeli conflict. The treaty was signed in 1979. Israel's withdrawal from the Sinai Peninsula was completed in 1982. Israel began to provide for Palestinian autonomy in 1994.

In 1981, Begin's government claimed legal and political authority over the Golan Heights, an area in Syria that bordered Israel. Syria and many other countries denounced this claim. Israel had gained control of the area in a war against Syria in 1967. Although Israel's relations with Egypt improved under Begin, relations with other Arab nations remained hostile. For more details on the Arab-Israeli conflict, see **Arab-Israeli conflict.**

Begin was born on Aug. 16, 1913, in Brest-Litovsk, Russia (now Brest, Belarus). In the 1930's, he became active in the Zionist movement. The Zionists called for the creation of a Jewish nation in Palestine, which was then ruled by the British.

Begin moved to Palestine in 1942. There he joined the Irgun Zvai Leumi, an underground Jewish militia that fought the British and the Palestinian Arabs. He led the Irgun from 1944 to 1948, when the nation of Israel was created in Palestine. Begin played a leading military role in the Arab-Israeli war of 1948. He served in the Knesset from 1949 to 1984. Malcolm C. Peck

Begonia, *bih GOHN yuh* or *bih GOH nee uh,* is the name of a large group of tropical plants, many of which are common household or garden plants. Most begonias have shiny leaves. Some types of begonias are valued for their brightly colored flowers, others for their colorful leaves.

There are three main types of begonias: (1) fibrous-rooted, (2) rhizomatous, and (3) tuberous. The fibrous-

©Michael Ellis

The wax begonia is a popular garden plant valued for its delicate flowers and its dark green, shiny leaves.

rooted type includes the wax begonia, a popular garden plant with pink, red, or white flowers and leaves that have a waxy appearance. Most rhizomatous begonias develop from a thick, rootlike underground stem called a *rhizome.* A popular rhizomatous begonia called a *rex begonia* is admired for its colorful leaves, which feature shades of red, white, or silver. Tuberous begonias grow from *tubers,* which are the swollen tips of underground stems. Tubers often have flowers that measure 4 to 6 inches (10 to 15 centimeters) across, and may be red, pink, orange, yellow, or white.

Scientific classification. Begonias make up the family Begoniaceae. James S. Miller

Behan, *BEE uhn,* **Brendan,** *BREHN duhn* (1923-1964), was a flamboyant Irish author. By the 1950's, he had established himself both as an author and as a well-known Dublin character. His colorful personality as well as his deep commitment to the ideals of a free Ireland helped make him one of the best-known Irish writers to emerge after the end of World War II in 1945.

Behan was born in Dublin. Like his father, he was a member of the Irish Republican Army (IRA), an organization dedicated to expelling the British government from Northern Ireland. British authorities arrested Behan several times for his IRA activities. From the age of 16 to 22, he spent all but six months in prison. In his autobiography, *Borstal Boy* (1958), Behan described his experiences in an English prison for boys.

Wide World

Brendan Behan

Behan is best known for two plays. *The Quare Fellow* (1954) concerns the feelings of the inmates and staff of a prison just before an execution. *The Hostage* (1958) tells about a young English soldier held prisoner by the IRA. Both plays reveal Behan's profound humanitarian feelings. Edward Hirsch

Behavior is the way human beings and other organisms act. Many people use the word *behavior* to mean *conduct*—that is, how a person's actions fit society's idea of right and wrong. But in psychology and other behavioral sciences, behavior is regarded as any activity of a person or other living thing. This article reflects the more general usage and focuses on human behavior.

The study of behavior

Most human behavior results from a combination of many factors. For example, a person might shout at someone who has insulted him or her. This response probably results from more than just the insult. It may be caused partly by being tired or hungry or by having been hurt by someone similar to the person now doing the insulting.

Although behavior has many causes, most scientists seek to isolate single causes. This makes the scientific study of behavior hard. Many researchers in psychology use controlled experiments in which they can examine the effect of one factor at a time on a particular kind of behavior. Some investigators design experiments to test the behavioral effects of several factors in various combinations. Still other researchers study behavior in the "real" world by observing people in their daily activities. Observing behavior outside controlled experiments cannot prove that one thing causes another. But studying people in the real world often helps scientists see the ways in which causes identified in experiments actually operate in people's daily lives.

Specialists in many fields study behavior. Psychologists and some biologists study animal behavior in controlled experiments. Other psychologists study individuals or small groups of people in controlled games or tasks to understand many aspects of behavior, including the reasons for people's feelings, thoughts, and motives. These studies help establish principles that can be used to explain, predict, and modify behavior. Educational researchers study how people behave in the classroom. In sociology, behavioral research focuses mainly on the behavior of people in large groups and social institutions, such as businesses, churches, governments, and hospitals. An anthropologist may live in an isolated community to study behavior patterns of a whole group.

Scientists from different fields carry out joint studies of specific problems of behavior. Many psychologists, educational researchers, sociologists, and anthropologists are concerned with the ways in which behavior is connected to physical illness. These scientists work together to learn why people adopt such harmful behavior patterns as smoking and overeating. The scientists also study how to encourage more healthy behavior.

Factors that affect behavior

Human behavior is determined partly by heredity and partly by environment. In addition, it can be modified through learning.

Heredity is determined by *genes.* Genes are short segments of the cell structures called *chromosomes,* which parents pass on to their offspring. Genes consist of chemical substances that give the offspring a tendency toward certain physical and behavioral qualities. The extent to which heredity influences behavior is hard to determine. For example, a person might inherit the genes to be an excellent pianist. But the person may never learn to play the piano well without early and continual training—and a piano on which to practice. In this way, genetic and environmental influences are intertwined in a person's behavioral development. Most scientists agree that genes have some influence over general intelligence and special aptitudes in such activities as athletics, mathematics, music, and science. But heredity is not the only factor involved in producing these characteristics.

Environment consists of the conditions and forces that surround and influence an organism. The environment can cause certain behavior. For example, unfamiliar surroundings may arouse curiosity or fear, depending on the circumstances. An intermediate level of arousal tends to have the most favorable effect on behavior. Extremely high or low levels of arousal may have a negative effect. A slight feeling of anxiety might help a student's performance on a test. But extreme anxiety could result in a poor performance.

Learning is the process by which behavior changes as a result of experience or practice. A person learns

much behavior through new environments that give examples of new behavior, provide instruction or opportunity to practice new behavior, and reward or punish new behavior. Learning takes place constantly because people are always being given new problems to solve or are being shown new ways of doing things.

Types of behavior

Behavior is often classified as *voluntary* or *involuntary.* Speaking at a meeting appears to be voluntary, and breathing heavily after running seems involuntary. But both types of behavior may change with experience. Deciding to speak at a meeting may in fact be determined by a person's previous experiences in speaking and keeping quiet at meetings. In addition, people may not breathe as heavily after running if they have learned how to increase their endurance. Thus, behavior may be hard to distinguish as voluntary or involuntary when it is examined closely.

Behaviorism

A major aspect of psychology called *behaviorism* developed from research on learning. It was introduced in 1913 by the American psychologist John B. Watson, who felt psychologists should study only observable behavior rather than states of consciousness or thought processes. He believed changes in behavior result from *conditioning,* a learning process in which a new response becomes associated with a certain stimulus.

Watson's approach to behaviorism was strongly influenced by the research of the Russian physiologist Ivan P. Pavlov during the early 1900's. Pavlov's experiments with animals proved that certain reflex actions can become conditioned responses to entirely new stimuli. For example, a dog's mouth begins to water as a reflex when the animal smells meat. Pavlov rang a bell each time he was about to give meat to a dog. Eventually, the dog's mouth began to water when Pavlov merely rang the bell. The flow of saliva had become a conditioned response to the ringing of the bell.

Watson demonstrated that responses of human beings could be conditioned in a similar manner. In one study, he struck a metal bar loudly each time an infant touched a furry animal. The sound scared the child, who in time became frightened by just the sight of the animal. Watson felt he could produce almost any response in a child if he could control the child's environment.

During the mid-1900's, the American behavioral psychologist B. F. Skinner became known for his studies of how rewards and punishments can influence behavior. He believed that rewards, or *positive reinforcements,* cause behavior to be repeated. Positive reinforcements might include praise, food, or simply a person's satisfaction with his or her own skill. Punishments discourage the behavior they follow. But punishment also encourages people to avoid situations in which they might be punished. Skinner concluded that positive reinforcement is more effective in teaching new and better behaviors. His work led to the development of teaching machines, which are based on positive reinforcement.

In procedures called *behavior modifications,* therapists use positive reinforcers to shape behavior in desired ways. For example, behavior modification has been used to help children with learning disabilities to learn basic school subjects. The children may receive smiles, hugs, or food for doing their schoolwork and behaving properly. In other behavior modification programs, children work for tokens or points. Later, they can exchange the tokens for candy, toys, or other rewards. Such programs have also proven effective with juvenile delinquents. Edwin B. Fisher, Jr.

Related articles in *World Book* include:

Alienation	Etiquette	Mental illness
Child	Habit	Motivation
Developmental psychology	Instinct	Pavlov, Ivan P.
Displacement behavior	Kinesics	Personality
Emotion	Learning	Skinner, B. F.
	Learning disabilities	Watson, John B.

Additional resources

Benyus, Janine M. *Beastly Behaviors: A Zoo Lover's Companion.* Addison-Wesley, 1992.
Gould, James L. and C. G. *The Animal Mind.* W. H. Freeman, 1994.
Halliday, Tim, ed. *Animal Behavior.* Univ. of Okla. Pr., 1994.

Behavior therapy. See Psychiatry (Psychotherapy).

Behavioral sciences. See Anthropology; Psychology; Sociology.

Behaviorism. See Behavior (Behaviorism); Psychology (Behaviorism).

Behn, *bayn* or *behn,* **Aphra,** *AF ruh* (1640-1689), was a dramatist, novelist, and poet. Using the pen name "Astraea," she was the first woman in England to become a professional writer and the first woman to be accepted as a playwright in the male-dominated English theater. Her fiction was important in the development of the English novel and her work influenced the novelist Henry Fielding. Behn wrote more than 15 plays and in her own time was best known as a dramatist. Today, she is best known for her novel *Oroonoko* (1688), a vivid, realistic story about a noble black prince of Suriname who is enslaved by cruel white men. The novel is an important antislavery document.

Behn was born in the county of Kent. She claimed to have learned the history of Prince Oroonoko while living as a child in Guyana. In 1666, King Charles II sent her to Holland as a spy. She returned to London in poverty a few years later and became a writer. She is buried in Westminster Abbey. Gary A. Stringer

Behrens, *BAIR uhnz* or *BAY ruhns,* **Peter** (1868-1940), was a German architect famous for his pioneering work in industrial architecture and design. Behrens developed an approach to designing factories and other commercial structures in glass, iron, and brick that gave them the grace and elegance of fine architecture.

Behrens was born in Hamburg. In 1907, he was appointed architect and product designer by the AEG Corporation, an electrical company. The buildings he designed for them, including the AEG Turbine Factory (1909), were a major influence on the development of modern architecture. His office was also a training ground for young architects, including Ludwig Mies van der Rohe, Walter Gropius, and Le Corbusier.

Nicholas Adams

See also Architecture (picture: The AEG Turbine Factory).

Behrman, *BAIR muhn,* **S. N.** (1893-1973), was an American playwright. Most of his plays deal with upper-class society. Using intelligent and witty dialogue, Behrman's characters discuss the complications of love and mar-

riage. Behrman's best works try to combine this kind of comedy with a concern for serious social problems.

Behrman's play *Brief Moment* (1931) deals with problems caused by the gap between rich and poor. In *Biography* (1932), *End of Summer* (1936), *Wine of Choice* (1938), and *No Time for Comedy* (1939), Behrman presented a cross section of political positions. He also confronted the problem of whether individuals should become politically involved. Samuel Nathaniel Behrman was born in New York City. Frank R. Cunningham

Beiderbecke, *BY duhr BEHK,* **Bix** (1903-1931), was an American jazz cornet player. Beiderbecke was the first white jazz musician to be widely admired by both black and white jazz performers. He was also a gifted pianist and composer. His most famous composition is *In a Mist,* which he recorded as a piano solo.

Beiderbecke was born Leon Bismarck Beiderbecke in Davenport, Iowa. In the 1920's he played with a number of pioneer jazz bands, including the "Wolverines" and saxophonist Frankie Trumbauer's orchestra. From 1927 to 1929, Beiderbecke was a soloist with Paul Whiteman's orchestra. But Beiderbecke's finest recordings were made with his own small groups or in partnership with Trumbauer. He died in New York City, virtually unknown. Frank Tirro

See also **Jazz** (picture).

Beijing, *bay jihng* (pop. 7,362,426), is the capital and second largest city of China. Only Shanghai has more people. The city's name is also spelled *Peking* (pronounced *pee KIHNG*). Beijing is famous for its beautiful palaces, temples, and huge stone walls and gates. Its art treasures and universities have long made the city China's cultural center. The Chinese Communists, who came to power in 1949, also made Beijing a leading industrial city. Beijing lies on a plain in northern China, about 100 miles (160 kilometers) inland from the Gulf of Zhili (also called the Po Hai Gulf or Bohai Gulf).

Beijing has been a center of government in China off and on for more than 2,000 years. Many rulers, including Mongol, Ming, and Manchu emperors, built palaces and temples in Beijing. Today, China's central government leaders live and work in Beijing.

The city. Beijing is part of the Beijing special municipal district, which has a population of about 11 million. The district consists of the central city, called the *Old City;* a series of suburbs; and farmland beyond.

The Old City consists of two large, rectangular areas called the *Inner City* and the *Outer City.* Walls once surrounded both areas. They are gradually being torn down, but roads and subways follow the original boundaries of the Old City.

The *Forbidden City* and the *Imperial City* lie within the Inner City. The Forbidden City includes palaces of former Chinese emperors. It is so called because only the emperor's household could enter it. The buildings in this part of Beijing are now preserved as museums. The Imperial City surrounds the Forbidden City. It includes lakes, parks, and the residences of China's Communist leaders. The *Gate of Heavenly Peace* (Tiananmen) stands at the southern edge of the Imperial City. This gate overlooks Tiananmen Square, where parades and fireworks displays take place on national holidays. The Great Hall of the People—China's parliament building—and the Museum of the Revolution and the Historical Museum border the square.

Commercial areas, residential areas, and parks make up much of Beijing's Outer City. The Temple of Heaven stands at the southern end of the Outer City. Chinese emperors used to go there to pray for a good harvest. The Summer Palace, where many of China's emperors lived during the summer, and tombs of Ming emperors lie northwest of the Old City of Beijing. Part of the Great Wall of China runs just north of Beijing.

In Beijing, as in cities elsewhere, many of the houses are old. Many people in the Old City live in one-story houses that border narrow, tree-lined alleys called *hutongs.* The hutongs branch out from the main boulevards. Peddlers walk up and down the hutongs selling such foods as fish, noodle soup, and vegetables. Suburbs to the north and northwest have many new apartment buildings. The Communists have built factories in the suburbs east and south of the Old City. Beijing and Qinghua universities are located in the northwest suburbs.

Emil Schulthess, Black Star

Beijing's Forbidden City includes palaces where China's emperors used to live. Chinese Communists use one of the palace courtyards to practice for a parade, *above.*

Artstreet

Carved stone gateways lead to a garden near Beijing's Temple of Heaven. Many buildings in Beijing have stone carvings.

People. Most of Beijing's people belong to the Chinese nationality called Han, which is the largest ethnic group in the country (see **China** [Nationalities]). Some Manchus and Mongols also live in the city. Most of the minority people in Beijing have adopted the customs and clothing of the Han people. Nearly all the people speak Northern Chinese (Mandarin), China's official language.

Education and cultural life. Nearly all children in Beijing go to elementary school. Most of them attend secondary school for at least a year. Beijing has more than 30 colleges, universities, and technical schools.

The National Library in Beijing is the largest in China. The city has more than 25 theaters. Beijing opera and ballet companies perform throughout China.

Economy. The Communists built many factories in Beijing after they took over. Beijing's factories produce chemicals, electronic equipment, farm machinery, iron and steel, and textiles. Coal mines in the city provide one of the raw materials of steel. Craftworkers in Beijing make porcelain, tapestries, and tiles.

There are many farms in Beijing outside the Old City. The farmers grow cotton, fruits, grains, and vegetables. They raise ducks, fish, and pigs. They also make light industrial products, such as baskets and furniture.

Government. Beijing lies in Hebei Province, but its government is independent of the provincial government. The Chinese Communist Party establishes government policies, and local leaders carry them out.

History. Beijing was founded as a trading center, probably about 2000 B.C. It served as the capital of the small state of Yen, which existed from about 400 to 200 B.C. The Khitans invaded China from Manchuria and established the Liao dynasty in A.D. 907. They soon made

Beijing

The municipality of Beijing, shown below, lies in Hebei province, but is administered as a special district. The map at the right shows many of Beijing's historical and architectural landmarks.

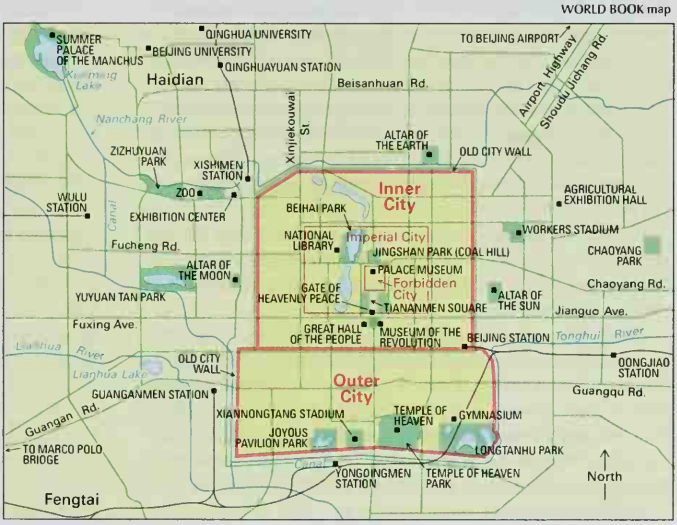
Park — Railroad

Main road — Point of interest

Beijing geographical area

0 250 500 Miles
0 250 500 750 Kilometers

WORLD BOOK map



0 5 10 Miles
0 5 10 15 Kilometers

Beijing one of their two national capitals. The Khitans called the city *Yenjing,* a name that is still sometimes used for Beijing.

The Mongols conquered China in the late 1200's and set up the Yuan dynasty. The Mongol leader Kublai Khan made Beijing his winter capital and began to build the city in its present form. Marco Polo, an Italian trader, visited Beijing in 1275 and praised its beauty.

The Ming rulers, who came to power in 1368, made Nanjing their capital. But they moved the capital to Beijing in the early 1400's. They first called the city *Beiping,* meaning *northern peace.* They later changed its name to *Beijing,* which means *northern capital.* The Manchu rulers, who succeeded the Ming rulers in 1644, enlarged Beijing and added many palaces and temples.

In 1860, France and Britain forced China to allow foreign diplomats to live in Beijing. In 1900, a group of Chinese called *Boxers* tried to drive the foreigners out of China. They killed a German diplomat in Beijing and many Chinese Christians in northern China. An army of eight nations, including Germany, Italy, Japan, Russia, and the United States, then attacked Beijing and destroyed many of the city's treasures (see **Boxer Rebellion**). After the last Manchu emperor fell from power in 1912, a series of local rulers called *war lords* controlled Beijing, the capital of the new Republic of China.

Japan gained control of treaty ports in Shandong Province early in 1919. Students in Beijing staged a protest against Japan's influence in China on May 4, 1919. They organized the *May Fourth Movement,* a drive aimed at restoring China's pride and strength.

The Chinese Nationalist Party captured Beijing from the war lords in 1928. Its leader, Chiang Kai-shek, made Nanjing China's capital and changed Beijing's name back to Beiping. In 1937, the Japanese defeated the Chinese at the Marco Polo Bridge south of Beijing and seized the city. Nationalist troops recaptured Beijing in 1945, but it fell to the Chinese Communists in 1949.

On Oct. 1, 1949, speaking at the Gate of Heavenly Peace, Mao Zedong declared the establishment of the People's Republic of China. The Communists renamed the city Beijing and made it China's capital. They built new buildings in Beijing, developed various industries in the suburbs, and organized the farmland into *people's communes* (collectively owned farm communities).

In 1976, a major earthquake struck the Beijing area. It was centered in the nearby city of Tangshan. The earthquake caused about 240,000 deaths. It also caused widespread property damage in the area.

In 1989, large numbers of people gathered in Tiananmen Square and demonstrated for more democracy. The military crushed the demonstrations and killed hundreds of protesters.

Tiananmen Square again became the site of protests in April 1999, when thousands of followers of the Falun Gong spiritual sect gathered to demand official recognition of their group. Instead, China's authorities outlawed Falun Gong. Despite international concerns about China's handling of these and other human rights matters, Beijing was chosen as the site of the 2008 Summer Olympic Games. Parris H. Chang

See also **China** (Protests; pictures).

Beirut, *bay ROOT* (pop. 1,500,000), is Lebanon's capital and largest city. It is also the country's chief commercial and cultural center. About a fourth of Lebanon's people live in the Beirut area. The city lies on the eastern shore of the Mediterranean Sea (see **Lebanon** [map]).

The main business district of Beirut, and most of the city's hotels and high-rise buildings, are on or near the seashore. The most modern section of the city, called *Hamra,* is known for its cafes, shops, motion-picture theaters, and nightclubs. Residential areas are divided into districts based largely on religion, social class, and ethnic group. Many middle- and upper-class Christians live in certain districts, and middle- and lower-class Muslims live in others. Palestinian refugees from the Arab-Israeli wars live in wretched, crowded camps in Beirut. The city's universities include the American University of Beirut, the Arab University, and St. Joseph University.

Beirut's chief economic activities are commerce and banking. A major international airport lies near the city.

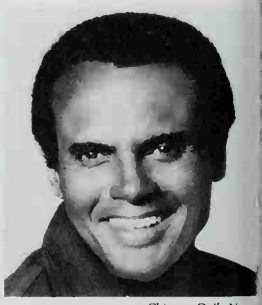
The Phoenicians founded Beirut about 3000 B.C. A series of foreign rulers controlled the city throughout most of its history. They included the Assyrians, Greeks, Romans, Ottomans, and French.

During the late 1800's, Beirut became a leading center of Arab learning and culture. In the 1900's, it grew into a financial and commercial center for the Middle East, and one of the most modern cities in that region. But a civil war between Lebanese Christians and Muslims in 1975 and 1976 destroyed Beirut's business district and crippled the city's economy. Some damage was repaired by the early 1980's, but continued fighting caused further damage. By 1991, peace had been restored. In 1996, Israel bombed Beirut in retaliation for rocket attacks against northern Israel by Muslim groups in southern Lebanon. A cease-fire soon ended the attacks on both sides. Malcolm C. Peck

See also **Lebanon** (History).

Belafonte, *BEHL uh FAHN tee,* **Harry** (1927-), an American singer and motion-picture actor, became best known for his interpretations of West Indian calypso music. He also popularized Asian and African songs, and American ballads, blues, and spirituals.

Belafonte was born on March 1, 1927, in New York City but lived in Kingston, Jamaica, from the ages of 8 to 13. He returned to New York City in 1940 and studied acting there. He tried to pursue a career in the theater but found work difficult to obtain. In 1949, he began a career as a jazz singer, with some success. It was through pursuing an interest in folk music, however, that he achieved his greatest fame. He searched out material through the Archive of Folk Song at the Library of Congress. He signed a recording contract in 1952 and reached the peak of his success from 1956 to 1962. Belafonte also appeared in several motion pictures, including *Carmen Jones* (1954), *Island in the Sun* (1957), *Buck and the Preacher* (1972), and *Kansas City* (1996). Paul F. Wells



Chicago Daily News

Harry Belafonte

Belaney, Archibald Stansfeld. See Grey Owl.

Belarus, *behl uh ROOS* or *byehl uh ROOS,* also spelled *Byelarus,* is a country in eastern Europe. Minsk is its capital and largest city.

The Belarusians trace their history to Kievan Rus, a state founded by East Slavs in the 800's. Belarus became part of Lithuania in the 1300's. It passed to Poland in the 1500's and to Russia in the late 1700's. A Communist government was established in Belarus in 1919. Belarus became a republic of the Soviet Union in 1922. It remained a Soviet republic until 1991, when it declared its independence.

Government. Under the constitution of Belarus, which became effective in 1996, a president is head of state and has broad powers over the government. The president appoints a prime minister, who heads the Council of Ministers. The country's legislature consists of two houses, an upper house called the Council of the Republic and a lower house called the House of Representatives. The council has 64 members. The House of Representatives has 110 members.

Belarus is divided into six provinces, each named for the capital of the province: (1) Brest, (2) Homyel, (3) Hrodna, (4) Minsk, (5) Mahilyow, and (6) Vitsyebsk. Voters elect a council to carry out the governmental functions of each province. The president, however, appoints regional executives, who supervise and appoint local executives. The appointed executives control the regional and local councils.

The Constitutional Court is the highest court of Belarus. The judicial system also includes a Supreme Court and provincial, city, and district courts.

The armed forces have about 95,000 members. Men who are 18 years of age or older must serve in the military for 18 months.

People. More than three-fourths of the people of Belarus are ethnic Belarusians, a Slavic people. About 13 percent are Russians. The population also includes small groups of Poles and Ukrainians.

Belarusian, the native language, and Russian are the official languages. Belarusian is a Slavic language that resembles Russian and Ukrainian. It is written in the Cyrillic alphabet, the same system of writing used for Russian. The government strongly promoted the use of Russian when Belarus was a part of the Soviet Union, so more people speak Russian than Belarusian, especially in the cities.

Facts in brief

Capital: Minsk.
Official languages: Belarusian and Russian.
Official name: Respublika Byelarus (Republic of Belarus).
Area: 80,155 mi² (207,600 km²). *Greatest distances*—north-south, 340 mi (545 km); *east-west,* 385 mi (620 km).
Elevation: *Highest*—Dzerzhinskaya Gora, 1,135 ft (346 m) above sea level. *Lowest*—Neman River at northwestern border, 295 ft (90 m) above sea level.
Population: *Estimated 2002 population*—10,175,000; density, 127 per mi² (49 per km²); distribution, 70 percent urban, 30 percent rural. *1989 census*—10,199,709.
Chief products: *Agriculture*—barley, cattle, flax, hogs, potatoes, rye, sugar beets. *Manufacturing*—bicycles, clocks, computers, engineering equipment, furniture, metal-cutting tools, motorcycles, plywood and paper, potassium fertilizer, refrigerators, television sets, textiles, trucks and tractors.
Flag: The flag has a wide red horizontal stripe above a narrower green stripe. A traditional embroidery pattern appears at the left. See **Flag** (picture: Flags of Europe).
Money: *Basic unit*—Belarusian ruble.

Bill Swersey, Gamma/Liaison

Minsk, Belarus's capital, lies on the Svisloch River. Minsk was almost entirely destroyed during World War II (1939-1945). It was rebuilt afterward as a modern city.

Most Belarusian families are small, with one or two children. Most city people live in apartments. Many of the rural people of Belarus work on large collective or state farms, which are run by the government. Many rural people live in small wooden houses or community housing blocks.

Most people who live in Belarus wear Western-style clothing. Traditional Belarusian costumes, which are white with colorful embroidery, are worn on special occasions.

Potato and mushroom dishes are particularly popular in Belarus. Many Belarusians also like thick stews, such hearty vegetable soups as turnip borsch, and rye bread and oat bread. Tea and coffee are the country's most popular beverages.

Belarusians enjoy a number of recreational activities. These include soccer, volleyball, track and field, swimming, camping, and chess.

Most of the people of Belarus follow the Eastern Orthodox faith and belong to the Belarusian Orthodox Church. The Belarusian Church long promoted Belarusian independence from the Soviet Union. As a result, it was banned from the 1920's until 1990, except for a brief period in the 1940's.

Roman Catholics form the second largest religious group in Belarus. Most of the Roman Catholics are Poles. Other religious groups include Protestants, Jews, and Muslims.

Most Belarusians finish high school, and many receive higher education. The country has several universities. The largest is the Belarusian State University in Minsk. Belarus also has a number of specialized academies and technical institutes.

The Belarusians are known for their weaving, straw-inlaid boxes, and other traditional handicrafts, and for

such performing arts as dancing and puppetry. The village of Neglyubka is famous for its textiles, which are woven in elaborate patterns.

In the early 1900's, two Belarusian poets, Yanka Kupala and Yakub Kolas, helped promote the use of the Belarusian language in literature. Formerly, most literary works were written in Russian or Polish.

Land. Most of the country consists of flat lowlands. Forests cover northern Belarus. A ridge of higher ground runs from northeast to southwest in central Belarus. The ridge includes the country's highest point, a hill called Dzerzhinskaya Gora that rises 1,135 feet (346 meters) above sea level. Southern Belarus is made up of marshes, swamps, and forests. This region includes a vast, forested swamp called the Pripyat Marshes.

The chief rivers of Belarus are the Bug, the Neman (also spelled *Nyoman),* the Western Dvina, and the Dnepr (also spelled *Dnyapro).* Belarus has over 10,000 lakes, mostly small ones.

The forests of Belarus teem with deer, foxes, hares, minks, and squirrels. A nature preserve lies along the border between Belarus and Poland. It is called the Belovezha Forest (Bialowieza in Polish), and it is a remnant of the virgin forest that covered much of Europe in prehistoric times. It has majestic old spruces and other trees. Its rare animals include a herd of European bison, also called *wisent.*

Climate. Belarus has cold winters and warm summers. The temperature averages about 22 °F (–6 °C) in January, the coldest month, and about 65 °F (18 °C) in July, the hottest. The country's annual precipitation ranges from 20 to 26 inches (50 to 66 centimeters).

Economy. Manufacturing produces more than half of the economic output of Belarus. The country is known for the heavy-duty trucks and tractors it produces. Belarus also manufactures computers, engineering equipment, metal-cutting tools, and such consumer goods as bicycles, clocks and watches, motorcycles, refrigerators, and television sets. The country's chief chemical product is potassium fertilizer. The forests yield many wood products, including furniture, matches, plywood, and paper goods.

Agriculture accounts for about a fourth of the country's economic output. The major crops include barley, flax, potatoes, rye, and sugar beets. Many farmers raise cattle and hogs.

Belarus has only a few mineral resources. It is rich in peat, which is used for fuel, and potassium and rock salts. Southern Belarus has coal and petroleum.

The major Belarusian exports include tractors to Australia, Canada, New Zealand, and the United States. Belarus's chief trading partners are Russia and Ukraine. Significant trade also occurs with Austria, Germany, Poland, Switzerland, and the United Kingdom.

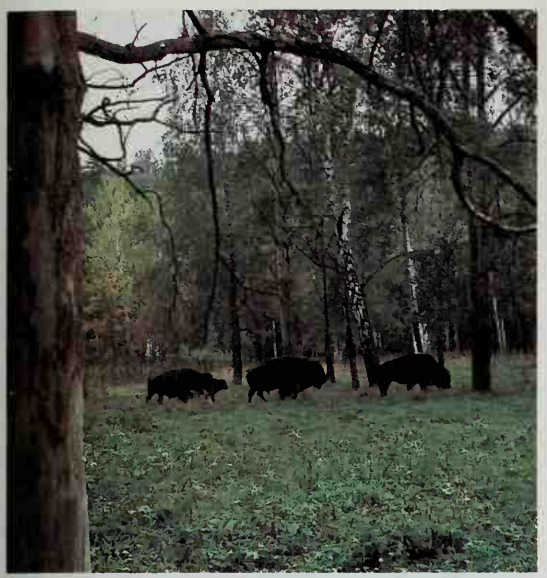
The country's transportation system includes railroad and highway networks connecting the cities of Belarus with other major European cities. Trains are the most important means of long-distance travel. The country's chief airport is in Minsk. Buses provide most of the transportation within cities. The Dnepr-Bug Canal and other canals improve water transportation by linking many of the rivers of Belarus with ports on the Baltic and Black seas.

About 215 daily newspapers are published in Belarus. Of those, 130 are published in Belarusian.

History. The area that is now Belarus was inhabited by various groups of people beginning in prehistoric times. Slavic tribes moved in by the A.D. 500's.

Belarus

WORLD BOOK maps



Novosti

European bison, or *wisent,* graze in the Belovezha Forest, a nature preserve that lies partly in western Belarus. The area is a remnant of ancient forest that once covered much of Europe.

The Belarusians, along with the Ukrainians and Russians, trace their history to the first East Slavic state. The state, called Kievan Rus, was formed in the 800's. Belarus made up the northwestern part of Kievan Rus. During the 900's and 1000's, Kievan Rus was a major European political, economic, and military power.

Lithuanian, Polish, and Russian rule. In the 1200's, Mongol invaders overran the eastern part of Kievan Rus, while Germanic tribes threatened from the west. To protect themselves from invaders, the Belarusians formed a military alliance with neighboring Lithuania. The alliance led to Belarus becoming part of Lithuania, which grew into a large and powerful state. Part of present-day Belarus first began to be called *Byelaya Rus,* meaning *White Russia,* in about the 1300's.

In 1386, the grand duke of Lithuania married the queen of Poland and began to rule both Lithuania and Poland as king. Lithuanian-Polish kings ruled the two states for nearly 200 years until Lithuania—including Belarus—merged with Poland in 1569.

Between 1772 and 1795, Russia, Prussia, and Austria divided Poland. Russia received much of eastern Poland, including Belarus. In the 1800's, Russian officials began a policy called *Russification.* This policy promoted the Russian culture and language at the expense of other cultures and languages, including Belarusian. Nevertheless, the Belarusian people's sense of national distinctiveness grew during the 1800's and 1900's, as did their resentment of Russian control.

Soviet rule. In 1917, revolutionaries known as Bolsheviks (later called Communists) seized control of the government. In March 1918, the Belarusians established an independent state called the Belarusian National Republic. But the Communists overthrew the republic later that year. In January 1919, they proclaimed a Communist-ruled state called the Byelorussian Soviet Socialist Republic. Poland gained control of western Belarus in 1919, at the start of the Polish-Russian War. In 1922, Byelorussia joined with three other republics to form the Soviet Union.

In the 1930's, Joseph Stalin, the dictator of the Soviet Union, pushed the policy of Russification in Byelorussia and other non-Russian republics. The Soviet government caused much suffering by seizing land from private farmers to form large state-run farms.

In 1939, the Soviets occupied western Belarus, which Poland had controlled since 1919, and reunited it with Byelorussia. Nazi Germany occupied Byelorussia and other Soviet territory from 1941 to 1944, during World War II. The area suffered great damage during the war. Minsk was almost entirely destroyed.

After the Nazis lost the war, the Soviets regained Byelorussia, including western Belarus. In 1945, Soviet Byelorussia became a founding member of the United Nations.

An explosion and fire that occurred at the Chernobyl nuclear power plant in Ukraine in 1986 had a major impact on Byelorussia. The winds caused about 70 percent of the radioactive fallout from Chernobyl to fall on Byelorussia. The radiation contaminated the republic's food and water supplies and caused many health problems, including increased cancer deaths.

Independence. In 1990, the Byelorussian parliament declared that the republic's laws took precedence over the laws of the Soviet Union. In August 1991, conservative Communist officials failed in an attempt to overthrow the Soviet Union's president, Mikhail S. Gorbachev. During the upheaval that followed, Byelorussia and several other Soviet republics declared their independence. In September, the republic changed its name from the Russian form *Byelorussia* to the Belarusian form *Belarus.* In December, Belarus joined with other republics in a loose association called the Commonwealth of Independent States (C.I.S.) to deal with their common economic, political, and military problems. Minsk became the administrative capital of the C.I.S. The Soviet Union was formally dissolved on December 25.

During the period that Belarus was a Soviet republic, the Communist government of the Soviet Union controlled the entire economy. After Belarus became independent, it planned to reduce government control of economic activities. The plans called for many inefficient state-owned factories, farms, and other businesses to close, and for the number of private businesses to grow. But the country's slow pace in changing to a free-market system led to reductions in international aid. As a result, Belarus moved to form closer ties with other former republics of the Soviet Union, especially Russia.

Recent developments. Aleksandr Lukashenko became president of Belarus in 1994, the same year the country adopted a new constitution. In 1996, however, Lukashenko pushed through a referendum for a new constitution that would expand his power. The referendum, which passed, extended Lukashenko's term to 2001 and gave him increased control over every branch of government. Opponents of Lukashenko said the vote had been falsified. They accused him of establishing a dictatorship and limiting the rights of the people. Lukashenko was reelected in 2001. However, government officials interfered with the campaign of his oppo-

nent, and independent observers of the election claimed the vote was unfair. Jaroslaw Bilocerkowycz

See also Commonwealth of Independent States; Minsk.

Belasco, *buh LAS koh,* **David** (1853-1931), was a leading American playwright, producer, and director. Many of his early plays were adaptations or collaborations. However, beginning with the Civil War romance *The Heart of Maryland* (1895), he became famous for staging his own plays. Later Belasco plays included *Madame Butterfly* (1900) and *The Girl of the Golden West* (1905). The Italian composer Giacomo Puccini turned both plays into famous operas. Belasco's productions were admired for their daring experiments with electric lighting, then in an early stage of development. His productions were also known for their realism. In one play, he faithfully re-created a restaurant, with characters brewing fresh coffee and making pancakes on stage.

Belasco was born on July 25, 1853, in San Francisco. His most successful years were spent in New York City, where he built several theaters. The performers who achieved stardom in his productions included David Warfield and Caroline Carter (known professionally as Mrs. Leslie Carter). Gerald Bordman

Belau. See Palau.

Belém, *buh LEHM* (pop. 1,203,151; met. area pop. 1,418,061), is a city in northern Brazil. It is the capital of Brazil's state of Pará and the main port of its Amazon Region. It lies on the Pará River, about 90 miles (140 kilometers) from the Atlantic coast (see **Brazil** [political map]). *Belém* is Portuguese for *Bethlehem.* The city was originally called *Santa Maria de Belém do Grão Pará* (Holy Mary of Bethlehem of Grand Pará).

Belém's industries include tourism and the production of rubber, Brazil nuts, cacao, and timber. Landmarks include Belém's oldest church, the Mercês, which was built in the early 1600's; and a cathedral and palace that date from the 1700's. The Goeldi Museum in Belém features exhibits on the Amazon Region. Belém was founded in 1616 as a military post. J. H. Galloway

Philippe Roy, Explorer

Belfast City Hall, a huge Renaissance-style building in Donegall Square, is a major landmark of the city.

Belfast (pop. 301,600) is the capital, largest city, and chief industrial center and port of Northern Ireland, a division of the United Kingdom. The city lies on Belfast Lough, a bay at the mouth of the River Lagan on Northern Ireland's east coast (see **Northern Ireland** [map]).

Donegall Square lies in the center of Belfast. In the square stands City Hall. The main street in the business district runs north from the square. Nearby buildings include the Royal Courts of Justice and St. Anne's Cathedral. Queen's University, to the south, is the largest university in Northern Ireland. Next to the university are the Botanical Gardens, which surround Ulster Museum.

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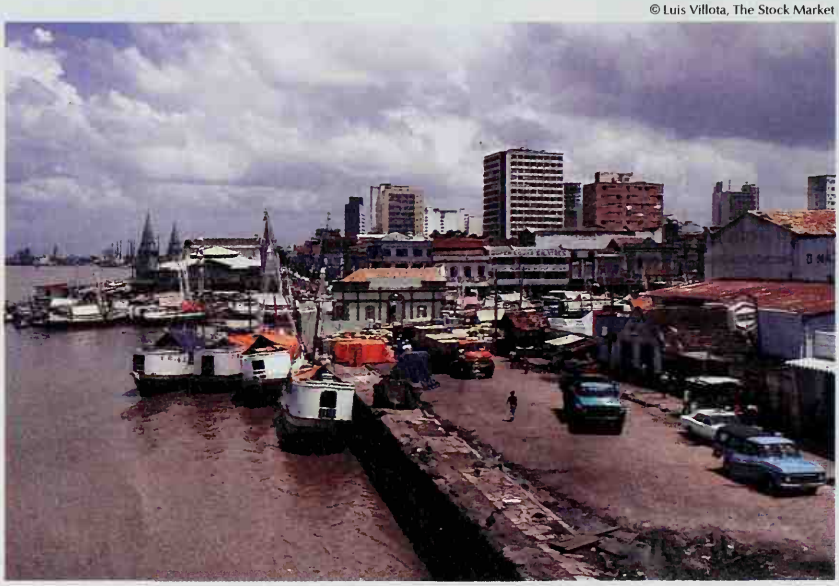

Belém lies along the Pará River in northern Brazil. The city is the capital of Brazil's state of Pará and the chief port of the country's Amazon Region.

The Parliament Buildings of Northern Ireland lie just outside the city. Docks and shipyards border the harbor on the east shore of Belfast Lough. Residential neighborhoods are scattered throughout the city. They include crowded areas of row houses and apartment buildings and uncrowded areas of single-family houses.

For many years, shipbuilding and textile manufacturing provided most of the jobs in Belfast. During the mid-1900's, these two industries declined, though they remain important. Belfast shipyards have built many warships and ocean liners, including the famous British liner *Titanic*. Textile factories in Belfast produce delicate Irish linen that is famous throughout the world.

Since the 1930's, the construction of aircraft has become an important part of Belfast's economy. The city's other major products include clothing, machinery, nonalcoholic beverages, processed foods, rope, soap, and tobacco.

English and Scottish settlers established Belfast as a trading center in 1613. During the 1800's, Belfast became an industrial city and major port. From 1801 until 1920, what are now Northern Ireland and Ireland formed one political division of the United Kingdom. In 1920, Ireland became independent. Northern Ireland remained a part of the United Kingdom, and Belfast became the capital of Northern Ireland.

During World War II (1939-1945), Belfast supplied the Allies with naval vessels and military aircraft. In 1941, the city suffered heavy damage from German air raids. During the 1950's, Belfast became a center of jet aircraft research. Since the late 1960's, there has been much tension between Protestants and Roman Catholics in Belfast over civil rights and political control of Northern Ireland. The Irish Republican Army (IRA) and other militant groups have carried out bombings and other terrorist activities in Belfast. A. T. Q. Stewart

See also **Northern Ireland** (picture: Belfast).

Belgian Congo. See **Congo (Kinshasa)** [History].

Belgian Malinois, *mal uh NWAH,* is a breed of dog closely related to the Belgian sheepdog. It is named for the town of Malines, or Mechelen, Belgium, where it originated in the late 1800's. The Malinois has a short-haired coat with longer hair along the back of the hind legs. It is usually light tan to brownish-red, with darker coloration on the face. A devoted companion, the Belgian Malinois has been used occasionally for police work. Critically reviewed by the American Kennel Club

Belgian sheepdog is a breed of dog developed in Belgium in the late 1800's to herd sheep. Except in the United States, the dog is known as the *Groenendael,* named for a town in Belgium. The dog has long black hair and stands from 24 to 26 inches (61 to 66 centimeters) tall at the shoulder. Belgian sheepdogs make devoted, protective companions and are known for their intelligence, agility, and herding instincts.

Critically reviewed by the Belgian Sheepdog Club of America

Belgian Tervuren, *TUR vurn,* is a breed of dog closely related to the Belgian sheepdog. It is named after the town of Tervuren, Belgium, where the breed originated about 1880. The adult Tervuren has a rich mahogany coat with black overlays on its face, ears, shoulders, and tail. Tervurens hold their ears stiffly erect and have long tails. These dogs make affectionate companions. Critically reviewed by the American Belgian Tervuren Club

WORLD BOOK photo by Walter Chandoha

The Belgian Malinois has a face mask of black hair.

© Callea Photo

A Belgian sheepdog has a long black coat.

WORLD BOOK photo by E. F. Hoppe

The Belgian Tervuren has long hair.

Wouters, Eureka Slide

Belgium's largest city, Antwerp, is a major European port. Antwerp lies along the Schelde River in northern Belgium. The graceful tower of the Cathedral of Notre Dame rises high above the city, which also has many modern buildings.

Belgium

Belgium is a small country at the crossroads of northwestern Europe. The country borders three important trading nations—France, the Netherlands, and Germany. A narrow body of water called the English Channel separates Belgium from the United Kingdom. Belgium's central location in Europe has brought it prosperity through trade with its neighbors. Historically, the country's location has also made it a battleground for soldiers of other nations, particularly during World War I (1914-1918) and World War II (1939-1945).

During most of its history, Belgium was a collection of cities and regions. Ancient Rome, Spain, Austria, France, and the Netherlands ruled it at different times. In 1830, Belgium won its independence from the Netherlands and became united as a state.

Belgium has two main ethnic groups, a Dutch-speaking people called Flemings, who live in the north, and a French-speaking people called Walloons, who live in the south. Both French-speaking and Dutch-speaking live in Brussels, Belgium's capital. A group of German-speaking people live in eastern Belgium.

Belgium is an international center of economic and political activity. A number of international organizations have headquarters in Brussels, including the European Union and the North Atlantic Treaty Organization (NATO). Many international companies have branch offices or factories in Belgium.

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Government

National government. Belgium is a parliamentary democracy with a constitutional monarchy. The Belgian Constitution, adopted in 1831, makes the monarch the head of state. Executive power lies in the hands of the prime minister, who is the head of government, and the cabinet, called the Council of Ministers. The cabinet has an equal number of Dutch-speaking and French-

Facts in brief

Capital: Brussels.
Official languages: Dutch and French.
Official name: Kingdom of Belgium.
Head of state: King.
Head of government: Prime minister.
Area: 11,783 mi² (30,519 km²). *Greatest distances*—east-west, 170 mi (274 km); north-south, 140 mi (225 km). *Coastline*—39 mi (63 km).
Elevation: *Highest*—Botrange Mountain, 2,277 ft (694 m) above sea level. *Lowest*—sea level.
Population: *Estimated 2002 population*—10,165,000; density, 863 per mi² (333 per km²); distribution, 97 percent urban, 3 percent rural. *1991 census*—9,978,681.
Chief products: *Agriculture*—barley, cattle, flax, hops, milk, potatoes, sugar beets, wheat. *Manufacturing*—cement, chemicals and chemical products, glass, leather goods, paper, processed foods, steel, textiles.
National anthem: "La Brabançonne" ("The Brabant Song").
Money: *Basic unit*—euro. One hundred cents equal one euro. The Belgian franc was taken out of circulation in 2002.

speaking members. The prime minister and the cabinet members hold office as long as they have the support of the Belgian Parliament.

The Belgian Parliament has two houses, the Chamber of Representatives and the Senate. The Chamber has 150 members, directly elected by the people. The Senate has 71 members. Voters directly elect 40 senators, provincial councils choose 21, and other senators elect 10. The members of Parliament have four-year terms. But the prime minister may request at any time that the monarch dissolve Parliament and call for new elections.

Regions and language communities. Belgium is a federal state that has three regions, and it also has three separate language communities. The regions, which have a large degree of self-rule, are (1) Flanders, in the north, (2) Wallonia, in the south, and (3) the capital district of Brussels. The three language communities are (1) the Flemish community, which consists of people who speak Dutch; (2) the French-speaking community, and (3) the German-speaking community.

Each of the three regions, Flanders, Wallonia, and Brussels, has its own prime minister and council of ministers and its own parliament, called the regional council. Voters elect members of the regional councils every five years. Each region has the power to make treaties concerning matters in its own area of responsibility. The regional governments control such matters as regional energy and environmental policy, communications, and public works. They also manage provincial and local governments and their financing.

Each of the language communities has a community council. The community councils are made up of members of the regional councils. The Flemish community council represents the Dutch-speaking population in Flanders and Brussels. The French community council represents French-speaking residents of Wallonia and Brussels. The German community council represents the German-speaking people in eastern Wallonia. These councils make decisions about culture, including language, museums, media, sports, and tourism. They also determine some policies in such areas as education and health and welfare.

The local government system includes two more levels, the 10 provinces of Belgium and the *communes* (cities and towns), of which there are close to 600. Each province has a governor, appointed by the monarch, as well as deputies and provincial councils elected by the people. Each commune has a mayor, appointed by the monarch, and a council elected by the people. Government in the provinces and communes takes care of such local matters as managing public property and providing law enforcement.

Politics. Belgium has three major political groups. Each group has French- and Dutch-language parties. The two Socialist parties support an increase in social services for Belgian citizens. The Liberal parties favor limits on government spending and encourage private business. The Christian Social parties generally represent a moderate or middle position in politics.

Belgium has many smaller parties. These parties represent regional, social, or economic concerns. A single party rarely is able to capture a majority, so parties must join forces and form a *coalition* (partnership) in order to gain control of the government.

Vance Henry, Taurus

Belgium's Parliament building in Brussels is called the Palais de la Nation (Palace of the Nation). It was completed in 1783 and houses the Belgian Senate and Chamber of Representatives.

Belgium's flag was first used during the revolt against Austrian rule in 1789. It became the national flag in 1830.

The Belgian coat of arms includes the national motto, *Union Provides Strength*, in French and Dutch.

WORLD BOOK map

Belgium lies in northwestern Europe. It borders the Netherlands, Germany, Luxembourg, France, and the North Sea.

Belgium map index

Cities and towns

Aalst	76,360	B	3
Aalter	17,333	B	2
Aarschot	26,920	B	4
Amay	12,797	C	5
Andenne	23,358	D	5
Anderlecht	88,111	C	4
Antwerp	462,880	B	4
Arlon	23,928	F	6
Asse	27,363	B	3
Ath	24,497	C	3
Aubange	14,562	F	6
Balen	18,921	B	5
Bastogne	12,567	E	6
Beaumont	6,314	D	4
Beauraing	8,050	D	5
Beringen	37,613	B	5
Bertrix	7,897	E	6
Beveren	43,719	A	3
Bilzen	28,293	B	6
Binche	32,884	D	3
Blankenberge	17,201	A	2
Bouillon	5,577	E	6
Boussu	20,621	D	3
Braine-l'Alleud	33,802	C	4
Braine-le-Comte	18,190	C	3
Brasschaat	36,507	A	4
Bredene	12,867	A	1
Bree	13,626	B	6
Bruges	116,724	A	2
Brussels	134,856	C	4
Charleroi	206,898	D	4
Châtelet	36,485	D	4
Chimay	9,762	E	4
Ciney	14,065	D	5
Courcelles	29,620	D	4
Couvin	13,009	E	4
Deinze	26,372	B	2
Dendermonde	42,651	B	3
Diest	21,579	B	5
Diksmuiden	15,385	B	1
Dinant	12,564	D	5
Dour	17,199	D	3
Duffel	15,409	B	4
Durbuy	9,030	D	6
Eeklo	19,141	B	2
Enghien	10,500	C	3
Esneux	12,959	C	6
Eupen	17,211	C	7
Evergem	29,942	B	3
Fleurus	22,628	C	4
Florennes	10,684	D	4
Florenville	5,697	F	5
Frameries	21,091	D	3
Geel	33,023	B	5
Gembloux	19,870	C	4
Genk	61,825	B	6
Geraardsbergen	30,541	C	3
Ghent	228,490	B	3
Gistel	10,324	B	1
Habay	6,531	E	6
Halle	33,487	C	3
Hamme	22,777	B	3
Hannut	12,417	C	5
Harelbeke	26,088	B	2
Hasselt	67,398	B	5
Heist-op-den-Berg	36,231	B	4
Herent	18,089	B	4
Herentals	24,913	B	5
Herstal	36,932	C	6
Hoogstraten	16,292	A	4
Houffalize	4,337	D	6
Huy	18,602	C	5
Ixelles	72,155	C	4
Izegem	26,501	B	2
Jodoigne	10,748	C	5
Kalmthout	16,557	A	4
Kapellen	25,114	A	4
Kasterlee	16,872	A	5
Knokke-Heist	32,326	A	2
Kortrijk	76,196	C	2
La Calamine	9,801	C	6
La Louviere	76,907	D	3
Landen	14,142	C	5
La Roche-en-Ardenne	3,981	D	6
Leopoldsburg	13,701	B	5
Lessines	16,332	C	3
Leuze	13,020	C	2
Libramont	8,891	E	5
Liège	195,389	C	6
Lier	31,574	B	4
Lierneux	3,230	D	6
Lokeren	35,492	B	3
Lommel	28,920	A	5
Louvain	86,328	B	4
Maaseik	21,930	B	6
Maas-mechelen	35,090	B	6
Maldegem	21,512	A	2
Malmédy	10,526	D	7
Marche-en-Famenne	15,655	D	5
Martelange	1,491	E	6
Mechelen	75,650	B	4
Menen	32,422	C	2
Merchtem	13,563	B	3
Mol	30,751	B	5
Mons	92,425	D	3
Mortsel	25,780	B	4
Mouscron	53,386	C	2
Namur	104,610	D	5
Neufchâteau	6,092	F	6
Nieuwpoort	19,459	B	1
Ninove	34,071	C	3
Nivelles	23,435	C	4
Oostkamp	20,768	B	2
Ostend	69,067	A	1
Oudenaarde	27,306	C	2
Overijse	23,382	C	4
Overpelt	11,908	B	6
Péruwelz	16,593	C	2
Philippeville	7,486	D	4
Poperinge	19,216	B	1
Rochefort	11,503	D	5
Roeselare	53,495	B	2
Ronse	24,403	C	2
Saint-Hubert	5,786	E	5
Saint-Ghislain	22,153	D	3
Saint-Vith	8,744	C	6
Schaarbeek	102,392	C	4
Schilde	19,363	A	4
Schoten	31,525	A	4
Seraing	61,439	C	6
Sint-Niklaas	68,336	B	3
Sint-Truiden	37,357	C	5
Soignies	24,135	C	3
Spa	10,432	C	6
Stavelot	6,438	D	6
Temse	24,382	B	3
Thuin	14,491	D	4
Tielt	19,459	B	2
Tienen	31,637	C	5
Tongeren	29,672	C	6
Torhout	18,441	B	2
Tournai	68,149	C	2
Tubize	21,014	C	3
Turnhout	38,534	A	5
Verviers	53,696	C	6
Veurne	11,357	B	1
Vielsalm	6,953	D	6
Vilvoorde	33,287	B	4
Virton	10,936	F	6
Visé	16,871	C	6
Walcourt	16,180	D	4
Waregem	35,574	B	2
Waremme	12,766	C	5
Waterloo	27,872	C	4
Wavre	29,416	C	4
Welkenraedt	8,466	C	6
Westerlo	21,024	B	5
Wetteren	22,684	B	3
Wevelgem	31,014	C	2
Wuustwezel	16,272	A	4
Ypres	35,434	B	1
Zedelgem	21,124	B	2
Zeebrugge		A	2
Zele	20,360	B	3
Zelzate	12,375	B	3
Zottgem	24,571	B	3

Source: 1994 official estimates.

All Belgian citizens who are 18 years of age or older must vote in national elections. Anyone who fails to vote may be fined.

Courts. Belgium's highest court is called the Court of Cassation. Five regional courts hear appeals of decisions made by lower courts. Special courts deal with such matters as labor disputes, commercial agreements, and military justice. An administrative superior court and a court of arbitration rule on conflicts between national and regional laws.

Armed forces. Belgium has about 40,000 men and women in its army, navy, and air force. Military service is voluntary.

People

Population and ancestry. Belgium is one of the most densely populated countries in the world. Antwerp is the largest city. Brussels is the capital and chief commercial center. The other major cities of Belgium are Charleroi, Ghent, and Liège.

Almost 60 percent of the Belgians are Flemings, and about 30 percent are Walloons. The Flemish language and culture originated in what is now northern Belgium after a Germanic tribe called the Franks settled the sparsely populated region in the A.D. 200's to 400's. The Walloon culture developed in the south, which was densely inhabited by Romans and Celtic tribes when the Franks arrived. The Roman influence remained strong there, and the Franks were largely absorbed by the local culture. A small number of Belgians in the east-central part of the country, along the border with Germany, are of German descent.

Languages. Belgium has two official languages—Dutch, which is spoken by the Flemings; and French, which is spoken by the Walloons. The Belgian dialect of Dutch, previously called Flemish, now is referred to as Dutch. The official language for education and all public communication is Dutch in Flanders, French in Wallonia, and German in a tiny area of eastern Belgium. Both Dutch and French are used in the city of Brussels.

Way of life. Most Belgians live in cities or towns. Many of them commute to jobs in other parts of the country. The European Union has its headquarters in Brussels. Foreigners have become an important part of the population. The Flemings and Walloons have cultural differences, but Belgians have been able to compromise. Their legal system balances the rights of the Flemings, the Walloons, and the residents of Brussels.

Bicycle racing and soccer are the most popular spectator sports throughout Belgium. On weekends, clubs of bicyclists of all ages ride through the countryside. Many Belgians vacation on the seacoast and spend short holidays in the Ardennes, a forested area in the southeastern part of Belgium.

Belgian cooking is famous. Two popular dishes are *carbonnades* (a beef stew made with beer) and *waterzooi* (a fish or chicken stew). Vegetable specialties include endive, leeks, and white asparagus. Street stands sell French fried potatoes, often with mayonnaise.

Religion. The Belgian Constitution guarantees freedom of worship. It also allows the government to grant financial support to all religions. About 85 percent of the people belong to the Roman Catholic Church, but less than 30 percent of them attend church regularly. However, many Flemings send their children to Catholic schools, and much Flemish political and social activity takes place in church-related organizations. About 1 percent of Belgians are Protestants, and more than 5 percent claim no religion.

Education. Almost all adult Belgians can read and write. The government funds both public schools and those operated by religious or other private groups. Educators praise Belgium's progressive preschools. More than 90 percent of Belgian children attend them, beginning at the age of $2\frac{1}{2}$ years. Young people from 6 through 18 years of age must attend school.

Children from 6 through 11 years of age attend elementary school. After elementary school, all students

P J. Sharpe, Superstock

In Brussels's main square, the Grand' Place, visitors may relax at an outdoor cafe. The buildings on the square date from the 1600's. They were built to house merchant and craft guilds.

attend *comprehensive* high schools. In these schools, the students take certain basic courses, but each student also specializes in technical, vocational, or college-preparatory subjects.

Belgium's oldest university is the Catholic University of Louvain, founded in 1425. In 1834, members of a worldwide secret society called Freemasons (Masons), together with political liberals, established the Free University of Brussels. Both universities have two separate campuses for the two languages. Belgium established state universities at Ghent and Liège in the early 1800's. In the last half of the 1900's, a number of universities opened, including Antwerp for Dutch-speaking students and Mons for French-speaking students. The government pays 95 percent of the expenses of the universities.

The arts. Many Belgians have made outstanding achievements in the arts, especially in painting. During the 1400's, such Flemish artists as Jan van Eyck and Rogier van der Weyden painted with careful attention to detail. During the 1500's, Pieter Bruegel the Elder painted colorful and detailed scenes of everyday life. Sir Anthony Van Dyck became one of the greatest portrait painters of the 1600's. Also during the 1600's, Peter Paul Rubens painted works noted for their brilliant colors. Demons and weird human figures appear in paintings by James Ensor, the finest Belgian artist of the 1800's. In the early 1900's, Paul Delvaux and René Magritte created *surrealist* paintings, which combine ordinary and dreamlike images.

The Flemish composers Johannes Ockeghem and Orlando di Lasso made great contributions to vocal music in the 1400's and 1500's. In the 1800's, César Franck expanded the classical style in his works for orchestra, organ, and piano. Adolphe Sax, a Belgian instrument maker, invented the saxophone about 1840.

Belgian literature includes two literatures, one in French and one in Flemish. During the 1800's and early 1900's, many of Belgium's best writers, such as Charles de Coster and Maurice Maeterlinck, were Flemings who wrote in French. De Coster's most famous work is the humorous novel *The Legend of Ulenspiegel* (1866) about the mischievous hero Till Eulenspiegel. Maeterlinck won the Nobel Prize for literature in 1911 for his plays, including *The Blue Bird* (1908) and *Pelléas and Mélisande* (1893). In the late 1800's, many Belgians who wrote in French contributed to a magazine called *La Jeune Belgique* (Young Belgium). Some of them, including Camille Lemonnier and Émile Verhaeren, formed a literary group also called Young Belgium. In 1920, Jules Destrée created the Royal Academy of French Language and Literature. Georges Simenon was a productive and widely read author of the 1900's. He wrote detective stories and other fiction in French.

In the mid-1800's, Hendrik Conscience became the first major Belgian author to write novels in Flemish. Guido Gezelle was the greatest Flemish poet of the 1800's. The Flemish poet and novelist Hugo Claus is the leading Belgian writer in the Dutch language since the mid-1900's. Louis-Paul Boon is a Flemish novelist who writes fiction based on actual events.

The land

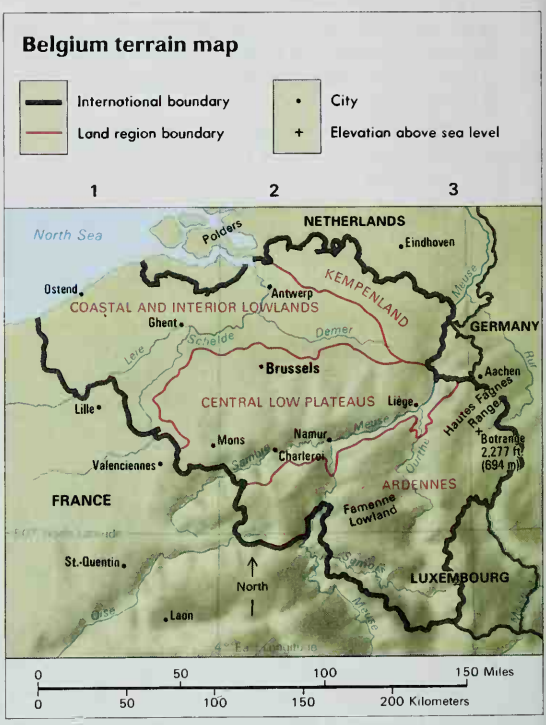
Belgium has an extremely varied terrain for a small country. Several rivers are large enough to serve as important transportation routes. These rivers include the Schelde, the Sambre, and the Meuse (or Maas). Belgium has no large natural lakes, but engineers created lakes in the southern part of the country by damming rivers.

The Coastal and Interior Lowlands extend across most of northern Belgium. Wide, sandy beaches lie along the 39-mile (63-kilometer) North Sea coast. As in the Netherlands, natural dunes and a system of sea walls and dikes protect the lowlands near the coast from flooding. These lowlands, called *polders,* form a humid, treeless plain crisscrossed by drainage canals.

Farther inland, the terrain becomes slightly rolling, with elevations as high as 300 feet (90 meters). The soil consists of a thin layer of sand over clay. However, the Belgians fertilize the soil and have made the region highly productive farmland.

The Kempenland, also called the *Campine,* lies in northeastern Belgium. It was a thinly populated region of birch forests and marshland until coal was discovered there in the early 1900's. Today, the Kempenland is an industrial center. In addition, drainage has made the land suitable for growing rye and other cereal crops. Many of the birch forests have been cleared and replanted with fast-growing evergreens for timber harvest.

The Central Low Plateaus occupy central Belgium. This region has Belgium's best soils. It is also the site of



WORLD BOOK map

Physical features

Ardennes (region)	B	3
Botrange (mountain)	B	3
Central Low Plateaus	B	2
Coastal and Interior Lowlands	A	2
Condroz (region)	B	3
Demer (river)	A	2
Famenne (valleys)	C	3
Hautes Fagnes (range)	B	3
Kempenland (region)	A	2
Leie (river)	A	1
Meuse (river)	B	3
North Sea	A	1
Ourthe (river)	B	3
Sambre (river)	B	2
Schelde (river)	A	2
Semois (river)	C	3

Ken Straiton, The Stock Market

Farmland covers almost half of Belgium. Only a small percentage of the workers are farmers, but they provide most of the country's food. The rolling fields at the left lie in eastern Belgium, near Hamoir, which is just south of one of Belgium's largest cities, Liège.

many of the nation's largest cities, including Brussels and Liège. The fertile valleys of the Sambre and Meuse rivers form the southern boundary of the Central Low Plateaus.

The Ardennes covers southeastern Belgium. A band of sandstone ridges and limestone valleys just south of the Sambre and Meuse rivers forms the northernmost part of the region. Farther south lie the woodlands of the Famenne, an area where rivers have carved numerous caves in soft limestone. The remainder of the Ardennes consists mainly of forest-covered hills separated by winding rivers. Botrange Mountain, the highest point in Belgium, rises 2,277 feet (694 meters).

The Ardennes is the least populated region and the least suitable for agriculture. Many deer, wild boars, and wildcats roam the forests of the Ardennes. Springs throughout the region are rich in minerals.

Climate

Belgium has a rainy climate with cool summers and mild winters. West winds blowing in from the sea bring the country much moisture and moderate temperatures. In Brussels, the temperature averages 35 °F (2 °C) in January and 64 °F (18 °C) in July. The temperature varies less along the coast and more in the Ardennes.

The coastal region averages 28 inches (71 centimeters) of precipitation a year. More than 40 inches (100 centimeters) fall yearly in the Ardennes. Snowfalls are common throughout the country, but snow seldom lasts long on the ground except in the Ardennes.

Economy

Belgium has a highly developed economy based on free enterprise, a system in which businesses operate with little government control. But the government owns and manages parts of the transportation and communication systems. It also provides basic social services and medical insurance coverage for all citizens.

Service industries employ about two-thirds of Belgium's workers. The most important service industries are community, social, and personal services, which include such areas as education, health care, and government. In addition, finance, restaurants, and wholesale and retail trade are important. Belgium's cities are the centers of most of its service industries. Brussels is a major European center of commerce, finance, and transportation.

Manufacturing employs about one-fourth of all Belgian workers. The production of engineering and metal products, including steel, ranks as Belgium's largest industry, followed by the production of chemicals and textiles. The steel industry was originally concentrated close to coal mines in Wallonia. Because the industry also uses imported petroleum to make steel, the newer steel plants lie near the ports in Flanders.

The Belgian chemical industry manufactures basic chemicals as well as drugs, explosives, pesticides, and plastics. Important textile products include carpets, synthetic fibers, and Belgium's world-famous lace. Belgium also produces cement, electronic products, glass, and paper. Food processing, including the manufacture of Belgian chocolates, also ranks as an important industry.

Agriculture. Farmers make up less than 5 percent of the Belgian work force, but they produce most of the nation's food. Farmland covers about 45 percent of the land. Belgian farms are small, averaging 44 acres (18 hectares) each. Most farms are run by families, many of whom rent the property.

Dairy farming and livestock production account for more than two-thirds of Belgium's farm income. About half the nation's farmland consists of pasture. The main crops are barley, potatoes, sugar beets, and wheat. Belgium also produces large quantities of flowers, especially azaleas, as well as fruits and vegetables.

Mining. Belgium's mining products include dolomite, granite, limestone, marble, and sandstone. The country's once-productive coal mines all closed during the last half of the 1900's because of high production costs and exhausted deposits.

International trade. Belgium depends heavily on international trade because the country has few natural resources and a small internal market for its finished

Broekart, Eureka Slide

Inland waterways are a major part of Belgium's transportation system. Barges like those pictured at the left carry goods over the country's nearly 1,000 miles (1,600 kilometers) of rivers and canals.

goods. Belgium belongs to several international organizations that promote trade and economic cooperation. These organizations include the Belgium-Netherlands-Luxembourg Economic Union, known as Benelux, and the European Union, an association of European countries that also works for political cooperation among its members. Belgium trades with a large number of nations. However, most of its trade is with other members of the European Union, especially Germany, the Netherlands, and France.

Machines and other engineering goods make up the largest share of imports and exports. Belgium also imports chemicals, diamonds, grains, and petroleum. Other major exports include chemicals, diamonds, glass products, processed foods, steel, and textiles.

Transportation. Belgium has one of the densest railroad networks in the world. The main system is about 2,500 miles (4,000 kilometers) long. The government owns most of the National Association of Belgian Railroads. Zaventhem International Airport, near Brussels, is a major international airport.

Antwerp ranks as Belgium's chief seaport and is one of the busiest ports in the world. Ghent and Zeebrugge are important inland ports. There are about 975 miles (1,570 kilometers) of inland waterways that provide transportation for goods.

Broekart, Eureka Slide

The manufacture of electronic products is centered in Flanders. The workers wear special clothing because even a particle of dust can damage the materials being produced.

Communication. Belgium has about 25 daily newspapers. One daily newspaper is published in German, and the rest are published either in Dutch or French.

Public corporations own and operate the radio and television systems. The corporations receive most of their income from annual fees paid by owners of radios and TV sets. The networks broadcast in Dutch and in French. Cable TV programs come from several European countries.

History

People have lived in what is now Belgium since prehistoric times. During the 100's B.C., Celtic tribes called the Belgae settled in the area. Roman forces led by Julius Caesar defeated the Belgae during the 50's B.C. The area then became part of the region that the Romans called Gallia (Gaul). Roman rule brought the development of cities, local industries, and an excellent system of roads.

The Middle Ages. By the later part of the A.D. 400's, a Germanic people called the Franks had driven the Romans out of northern Gaul. Clovis, a Frankish king, founded a kingdom that included the Belgian region. The baptism of Clovis in 496 established Christianity as the state religion. During the late 600's, the descendants of Clovis lost control of the kingdom to a family of Frankish rulers called the Carolingians. Charlemagne, the greatest of the Carolingians, ruled from 768 to 814. Under his reign, Belgium became the center of a large empire that covered much of western Europe.

In 843, Charlemagne's three grandsons divided his empire among themselves into three kingdoms. By the 900's, the Carolingians had lost much of their power. This led to the rise of feudal states, under which local lords provided land and protection to nobles in exchange for military and other services. Belgium became an important center of trade and industry during the feudal period, which lasted about three centuries. In many towns, merchant *guilds* (associations) obtained town charters from the feudal lords. The charters promoted the economic interests of the towns and granted numerous special privileges to merchants.

During the 800's, the counts of Flanders emerged as strong rulers. By the 1000's, other aristocratic families had established their own rule in territories that later became provinces. These included Brabant, Hainaut, Limburg, and Namur.

In 1302, a French army tried to enforce control over the Flanders area. Local peasants and skilled workers defeated the armored French knights. Every year on July 11, Flanders celebrates this victory as a public holiday.

Brussels and its surrounding area made up the duchy of Brabant. In 1354, when the Duke of Brabant needed money, he granted governmental powers to the church, the nobles, and the towns in exchange for taxes from the people. The document granting these powers is the *Joyeuse Entrée* (Joyous Entry). It is similar to England's Magna Carta. Its name refers to the official entry into Brussels in 1356 of the duke's daughter, who had inherited the duchy after her father's death. Upon her arrival in Brussels, she swore to uphold the agreement.

Towns and cities grew, especially in Flanders and Brabant. Bruges became a center of commerce. Ghent produced much of the cloth for Europe. By the end of the Middle Ages in the late 1500's, about one-third of the people in the Belgian area lived in towns and cities.

Habsburg rule. In 1477, the marriage of Mary of Burgundy and Maximilian of Austria brought the Low Countries (now Belgium and the Netherlands) under the rule of the Habsburg family of Austria. In 1506, their grandson Charles inherited the Low Countries. In 1516, Charles inherited Spain, and in 1519, he became Holy Roman Emperor Charles V. He was born in Ghent, and many of his advisers were from the Low Countries. In 1555 and 1556, Charles gave up the Low Countries, Spain, and Spanish territories to his son, who became Philip II of Spain. Charles's brother Ferdinand received Austria and became Holy Roman Emperor.

Philip had fewer ties with the Low Countries than his father. He considered himself defender of the Roman Catholic faith, and he persecuted the Protestants in the Low Countries. He also tried to centralize the region's administration at the expense of the local nobles and cities. In 1566, the Low Countries rebelled. In response, Philip sent the Duke of Alba from Spain with thousands of Spanish soldiers. The duke governed cruelly and imposed harsh new taxes. Many local nobles and Protestants left the region. William I, Prince of Orange, led the local forces that opposed the Spaniards.

The conflict lasted until 1648. Local forces held the northern part of the Low Countries, partly because their ships controlled the sea. The north, which later became the Netherlands, declared its independence in 1581. Spain finally recognized it in 1648.

The local forces lost to the Spaniards in the south, which remained under Spanish control. The split between the north and south damaged the south's economy. Trade decreased, partly because Flemish shipping was prohibited on the River Schelde from Antwerp to the sea. Also, many commercial leaders and artists moved to the new republic in the north. In the rest of the 1600's, the area began to lose its economic strength.

During the second half of the 1700's, Belgian farmers increased their productivity by growing new crops, especially potatoes, and by using better tools and such new farming techniques as crop rotation. Belgian industries also improved. The Ghent and Verviers areas produced textiles. The Liège and Charleroi areas developed and expanded mining and metal production.

The Brabant Revolution. The Belgian area became an Austrian possession in 1713. From 1781 to 1787, Holy Roman Emperor Joseph II, who ruled Austria, tried to change the administrative, legal, educational, and judicial systems in the Belgian provinces. He ordered his own reforms, ignoring the protests of the local provincial legislatures. Led by two lawyers, Henri Van der Noot and Jan Vonck, the Belgians wrote a declaration of independence. In 1789, Belgian forces fought the Austrians and defeated them within three months in an uprising called the Brabant Revolution. In January 1790, the Belgians established an independent republic, the États Belgiques Unis, a federation of provinces modeled on the federation of states in the United States. Austria regained control of the area by the end of the year.

In the early 1790's, French armies invaded Belgium and eventually drove out the Austrians. Belgium became part of France in 1795. The French ruled the area for 20 years. During that time, the French legal and educational systems replaced the existing systems, and the French language became dominant.

In 1815, France's Emperor Napoleon I met his final defeat at the Battle of Waterloo in central Belgium. From late 1814 through early 1815, European political leaders met at the Congress of Vienna to remap the continent. They united Belgium, Holland, and Luxembourg into the Kingdom of the Netherlands as a barrier against future French expansion. Belgium's economy grew rapidly under the union. But the Belgians became dissatisfied with Dutch government policies concerning education, language, and politics. Also, most Belgians were Roman Catholics and objected to the rule of Dutch Protestants.

Independence. Opposition to the Dutch government grew, and the Belgians revolted in August 1830. On October 4, Belgium declared its independence. In December the major European powers—Austria, Britain, France, Prussia, and Russia—recognized Belgian independence. The next month, these countries signed an agreement guaranteeing the independence and neutrality of the new nation.

In 1831, Belgium chose as its king Prince Leopold of Saxe-Coburg-Saalfeld, whose niece later became Queen Victoria of Britain. The new country adopted a liberal constitution that guaranteed such rights as freedom of religion and freedom of the press.

Belgium was one of the first countries in Europe to industrialize. Coal and steel industries began in the south, but the north remained mainly agricultural. The government followed a free enterprise system in economics, and it did not regulate the early Belgian industries. In the 1830's, Belgium became one of the first countries to build a railroad. The government soon developed a national railroad to connect the whole country. In fact, Belgium was one of the first countries to have a national railroad. Belgium greatly expanded its international trade during the remainder of the 1800's.

In 1865, Leopold II succeeded his father as king. The new monarch wanted Belgium to possess a colony in central Africa. After the Belgian government refused to act, Leopold sent his own explorers to Africa. In 1885, the monarch established the Congo Free State as his pri-

vate colony. The Congo supplied Belgium with rubber, ivory, and other valuable resources. However, the king's agents treated the Africans brutally and refused to recognize African property rights to lands that the Africans held in common. Protests in Belgium, Britain, and the United States forced the king to surrender control of the Congo to the Belgian Parliament in 1908. The name of the region became the Belgian Congo.

Relations between the Flemings and the Walloons grew increasingly tense during the late 1800's. Until that time, French-speaking people had largely controlled the government and the economy. The Flemings won recognition of Dutch as an official language in the late 1800's. A series of laws passed in the 1930's established equality between the two languages. However, conflict between the Flemings and the Walloons continued during the 1900's as each of the two groups sought to advance its own economic and cultural interests.

The world wars. The nephew of Leopold II became King Albert I in 1909. He led Belgium's military forces during World War I. On August 4, 1914, Germany invaded Belgium and swept through the country into France. By late November, German troops occupied all of Belgium except a small corner in the northwest. The Belgian government went into exile in France. Nearly a million Belgians fled to Britain, France, and the Netherlands. The country became the scene of many bloody battles between the Central Powers, led by Germany, and the Allies, led by Britain and France. In September 1918, Allied forces began the liberation of Belgium, which became complete when the Germans surrendered in November.

The Treaty of Versailles, which officially ended the war with Germany, gave Belgium the German territories of Eupen, Malmédy, St. Vith, and Moresnet. Belgium also received control of the German East African region of Ruanda-Urundi (now the nations of Rwanda and Burundi). German payments for war damages and international aid helped the Belgian economy recover. The three Belgian political parties joined in a series of cooperative governments that worked to rebuild the economy and to secure diplomatic treaties.

Important dates in Belgium

50's B.C. Roman forces led by Julius Caesar conquered what is now Belgium.

A.D. 400's Clovis, a Frankish king, founded a kingdom that included the Belgian region.

1300's and 1400's The dukes of Burgundy ruled Belgium.

1477 The Habsburg family of Austria gained control of Belgium.

1516 Belgium became a Spanish possession.

1713 Spain returned Belgium to Austria.

1789 Belgium revolted against Habsburg rule in an uprising called the Brabant Revolution.

1795 Belgium became part of France.

1815 Belgium and the Netherlands were united.

1830 Belgium declared its independence from the Netherlands.

1885 King Leopold II of Belgium established the Congo Free State, later called the Belgian Congo.

1914-1918 Belgium fought on the Allied side in World War I and suffered much destruction.

1940-1945 Fierce fighting occurred in Belgium between the Allies and Germany during World War II.

1949 Belgium became one of the founding members of the North Atlantic Treaty Organization (NATO).

1957 Belgium helped establish the European Economic Community, which led to the country's eventual membership in the European Community and the European Union.

1960 Belgium granted independence to the Belgian Congo.

1971 Revisions of the Constitution divided Belgium into three cultural communities based on language.

1980 Parliament approved constitutional reforms granting limited self-rule to Flanders and Wallonia.

1993 Belgium became a federal state, with separate regional legislatures.

Belgium again became a battlefield during World War II. German forces invaded the country on May 10, 1940. The Belgian army surrendered 18 days later. King Leopold III remained in German-occupied Belgium, but the Belgian cabinet moved the government to London. In September 1944, Allied forces liberated the country. In December, the Germans invaded southeastern Belgium, but the Allies repelled the attack and won a major

The Low Countries, including most of Belgium (outlined in red), came under Spanish rule in the 1500's. The north won independence in 1648.

The southern Low Countries passed from Spain to Austria in 1713. The French drove out the Austrians in 1794 and made the area part of France in 1795.

WORLD BOOK maps

The Kingdom of the Netherlands united Belgium and the Netherlands in 1815. Belgium declared its independence from the Netherlands in 1830.

victory at the Battle of the Bulge. World War II caused less physical destruction in Belgium than did World War I. However, the loss of life among civilians was much greater in World War II.

After World War II, Belgium became one of the first countries in Europe to recover economically. However, Belgium faced a major crisis over what was called the "royal question." Many Belgians bitterly criticized King Leopold III for staying in Belgium during the war. Some even accused the king of having cooperated with the Germans. In 1950, it appeared that Leopold's continued reign would lead to civil war. He therefore gave the royal authority to his oldest son, who officially became King Baudouin I in 1951. Baudouin was a popular king. Many Belgians believe that he helped keep the country from splitting apart.

Belgium played a leading role in international affairs during the postwar years. It became a founding member of the United Nations (UN) in 1945. The next year, the Belgian statesman Paul-Henri Spaak served as the first president of the UN General Assembly. In 1949, Belgium joined 11 other nations in forming the North Atlantic Treaty Organization (NATO). Belgium was part of the movement toward European political and economic cooperation and helped to found the European Economic Community (EEC). This organization became part of the European Community and, later still, was incorporated into the European Union.

In 1956, the people of the Belgian Congo issued a declaration demanding thorough political change. The Belgian government granted only gradual and limited reforms. There was conflict in the Congo during the late 1950's, and Belgium gave up the colony in 1960. In 1962, Belgium ended its supervision of Ruanda-Urundi.

After World War II ended in 1945, Flanders's economy became stronger than Wallonia's, reversing the trend of the previous century. In Flanders, high-technology industries began to develop. In Wallonia, the heavy industries founded in the 1800's began to weaken. Tensions between the Flemings and the Walloons increased during the 1960's. New political parties, concerned with the controversial language problem, gained strength. In 1971, Parliament revised the Constitution to recognize three cultural communities based on language: a Flemish community, a French one, and a German one. The new Constitution also established three economic regions: Brussels, Flanders, and Wallonia.

Recent developments. In 1993, the government passed a law that officially made the country a federal state, consisting of the regions of Flanders, Wallonia, and Brussels. King Baudouin died in 1993. His brother became King Albert II.

In the late 1990's and early 2000's, Flanders experienced strong economic growth, but Wallonia faced high unemployment. The division among Belgium's language communities continued to interfere with cooperation between the two regions.

Janet L. Polasky

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Baudouin
Bruegel, Pieter, the Elder
Campin, Robert
Ensor, James
Franck, César
Maeterlinck, Maurice
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Walloons

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Questions

What language do the Flemings speak? What language do the Walloons speak?
Which area of Belgium is the least populated?
What was the "royal question," and how was it resolved?
How has Belgium's location affected its history and economy?
Why does Belgium depend heavily on its trade with other countries?
When did Belgium declare its independence from the Netherlands?
What are some international organizations that Belgium helped found?
Why did Belgium's coal mines close?
What is Belgium's chief seaport?
Who are some of Belgium's most famous artists?

Additional resources

Kossmann, Ernst H. *The Low Countries, 1780-1940.* Oxford, 1978. Standard history of Belgium and the Netherlands.
Müller, Kristiane, and others. *Belgium.* 3rd ed. APA Productions, 1998.
Stallaerts, Robert. *Historical Dictionary of Belgium.* Scarecrow, 1999.
Wickman, Stephen B., ed. *Belgium: A Country Study.* 2nd ed. U.S. Government Printing Office, 1984.

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Belgrade is the capital and largest city of Yugoslavia. Its newer section, *shown here,* has many tall, modern buildings.

Belgrade, *BEHL grayd* or *behl GRAYD* (pop. 1,168,454), is the capital and largest city of Yugoslavia. Its name in the Serbo-Croatian language is *Beograd.* Belgrade serves as a major river port and railroad center. It lies in Serbia, at the junction of the Danube and Sava rivers (see **Serbia** [map]). The city's location has made it a part of political and military struggles for hundreds of years. Invading armies have conquered and destroyed Belgrade more than 30 times.

The city covers about 71 square miles (184 square kilometers). The most modern section, known as New Belgrade, is on the east bank of the Sava River. The oldest section, called Kalemegdan, lies on a nearby hill that overlooks both the Sava and the Danube.

Belgrade has a number of museums, including the Ethnographical Museum and the Fresco Gallery. Theaters in Belgrade present ballets, concerts, plays, and operas. Many parks, including Kalemegdan, Tashmajdan, and Topchider, dot the city. The University of Belgrade is in the city.

People. Most of Belgrade's people are Serbs, but the population also includes Albanians, Hungarians, Montenegrins, and other groups. The majority of the people use the Serbo-Croatian language. Most of the Serbs belong to the Eastern Orthodox Church.

Economy. The government employs a large number of people in Belgrade, and many others work in banking or commerce. The products made by Belgrade's industries include automobiles, electrical equipment, farm machinery, flour, paper, shoes, sugar, and woolen textiles.

History. During the 300's B.C., Celtic tribes settled on the site of what is now Belgrade. The Romans later captured the settlement, which they called Singidunum, and it developed into a city. As the Roman Empire declined, Slavic tribes took over the city and renamed it Belgrade.

In 1404, Belgrade became the capital of the Serbian kingdom. The Turks captured the city in 1521. The Turkish and Austrian empires fought each other during the 1700's, and Belgrade changed hands between them several times.

During the 1800's, Belgrade was a center of revolutionary activity by Serbian nationalists fighting for Serbia's independence from Turkish rule. Serbia won complete independence from Turkey in 1878, and Belgrade remained the country's capital.

Austro-Hungarian forces occupied Belgrade during World War I (1914-1918). In 1919, the city became the capital of the newly created Kingdom of the Serbs, Croats, and Slovenes (later Yugoslavia). The Germans occupied Belgrade during most of World War II, from 1941 to 1945.

Belgrade grew rapidly after World War II and had many of the problems that faced other growing cities. For example, Belgrade experienced a housing shortage and began to build many apartment buildings. During this time, serious air pollution also developed. The pollution resulted from automobile exhaust fumes and the smoke produced by coal burned as fuel by industries and homes.

Today, Belgrade's way of life combines modern Western influences with traditions of the Balkan Peninsula. For example, the city has skyscraper apartment buildings, supermarkets, and traffic problems. But it also has an almost countless number of coffee houses, quiet streets, and restaurants. Sabrina P. Ramet

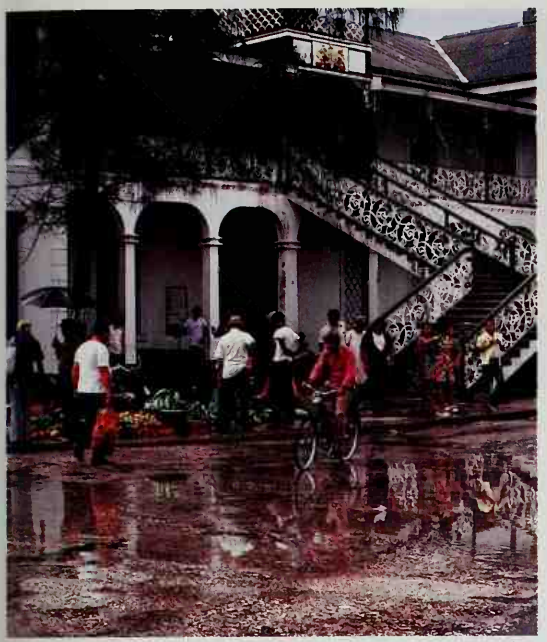
See also **Serbia** (picture).

Belize, *beh LEEZ,* is a small country in Central America. It lies on the southeast coast of the Yucatán Peninsula. Belize is bordered by Mexico on the north, the Caribbean Sea on the east, and Guatemala on the south and west. More than half of Belize's people live along the Caribbean coast. Belize City, on the coast, is the country's largest city. Belmopan, which was created to become the nation's capital in 1970, is inland.

Belize is Central America's most thinly populated country. It is also the only Central American country where English is the official language and people of African descent make up the largest part of the population.

Facts in brief

Capital: Belmopan.
Official language: English.
Area: 8,763 mi² (22,696 km²). *Greatest distances*—north-south, 180 mi (290 km); east-west, 85 mi (137 km). *Coastline*—220 mi (354 km).
Elevation: *Highest*—Victoria Peak, 3,680 ft (1,122 m) above sea level. *Lowest*—sea level along the coast.
Population: *Estimated 2002 population*—251,000; density, 29 per mi² (11 per km²); distribution, 50 percent rural, 50 percent urban. *1991 census*—189,774.
Chief products: *Agriculture*—bananas, corn, grapefruit, oranges, sugar cane. *Forestry*—pines, tropical hardwoods. Fishing—conches, lobsters, shrimp. *Manufacturing and processing*—cement, clothing, sugar.
National anthem: "Land of the Free."
Flag: A wide horizontal blue stripe is bordered by narrow horizontal red stripes at the top and bottom. The country's coat of arms appears on the blue stripe. See **Flag** (picture: Flags of the Americas).
Money: *Basic unit*—Belizean dollar. One hundred cents equal one dollar.



Jean-Pierre Courau, Explorer

Belize City is the only city in Belize. Belizeans purchase produce at markets such as the one above.

Belize became an independent nation in 1981. It had been a British colony since 1862. From its colonial days until 1973, Belize was called *British Honduras.*

Government. Belize is a constitutional monarchy that functions as a parliamentary democracy. It belongs to the Commonwealth, an organization of former British colonies, and the Organization of American States, an association of North and South American countries. A prime minister heads the government. The prime minister, with the aid of 10 Cabinet ministers, carries out the operations of the government. The National Assembly, which consists of the 28-member House of Representatives and the 8-member Senate, makes the country's laws.

The people elect the House members. The leader of the political party that wins the most seats in the House of Representatives serves as prime minister. A governor general represents the British monarch. The governor general appoints the eight senators. Five senators are appointed on the advice of the majority party in the House, and two are appointed on the advice of the minority party. The other senator is appointed on the recommendation of the governor general's advisory council.

People. About half of the people of Belize have full or partial black African ancestry. About a fifth of the people are descended from Carib, Maya, or other Indian groups. *Mestizos,* people of mixed white and Indian ancestry, also account for about a fifth of the country's population. Most of the rest of the people who live in Belize are of European, East Indian, Chinese, or Lebanese descent.

English is the country's official and most widely used language, followed by Spanish. Many people speak both English and Spanish. Some people speak Maya or Arawak Indian languages. About 60 percent of the people are Roman Catholics. Most of the rest are Protestants.

Most Belizeans are poor. Unemployment in the cities and low farm production in rural areas of the country are major problems.

Belizean children between the ages of 5 and 14 must attend school. Belize has three colleges. The country faces shortages of technicians and of professionals, especially doctors. Many Belizeans who learn such occupations move to other English-speaking countries in search of advancement.

Land and climate. Most of the coastal area of Belize is a swampy lowland. Offshore lie numerous small islands and an unnamed barrier reef that ranks as the second-longest barrier reef in the world. Only the Great Barrier Reef off the coast of Australia is longer. Inland, in the south, the land of Belize rises gradually to the low peaks of the Maya Mountains. This range includes the country's highest point—Victoria Peak—which rises 3,680 feet (1,122 meters) above sea level. Northern Belize is generally flat. The country was once nearly all forested. But over half of the forests have been cut down for lumber or other products or cleared for farming.

WORLD BOOK maps

Mahogany logs from a Belizean forest are loaded onto a truck for transport to a lumber mill. Belize exports such tropical hardwoods as cedrela and mahogany.

© Karl Kummels, Shostal

Belize has a hot, humid climate. Temperatures range from 60 to 90 °F (15.6 to 32 °C) along the coast but are often higher inland. Annual average rainfall measures from 50 inches (130 centimeters) in the north to over 150 inches (380 centimeters) in the south. Rain falls almost every day, except during the dry season from February to May. Hurricanes sometimes strike Belize.

Economy. Belize is a developing country. Its economy is based on agriculture. Sugar cane, which is raised on plantations, ranks as the country's chief crop. Oranges, grapefruits, and bananas are next in importance. Processed sugar is the main export. The country's forests yield lumber, including pine and such tropical hardwoods as cedrela and mahogany. The Caribbean Sea provides conchs, fishes, lobsters, and shrimp. Most of Belize's industries are small. They include sugar refining, processing foods and wood, and the production of clothing, cement, and bricks.

Belize receives much financial aid from other countries. Its government encourages foreign investment to create jobs. Belizeans are working to develop the tourist industry by building hotels and other facilities.

Belize has an international airport. A government-operated radio network and several private radio and television stations broadcast in the country.

History. Maya Indians moved from the Guatemalan Highlands into what is now Belize in about 1000 B.C. Maya civilization developed and flourished in the Belize area until about A.D. 1000. Historians know little about life in Belize from that time until the early 1500's, when Spaniards reached the coastal area.

In the 1520's, Spain claimed the Belize area and made it a part of the Captaincy General of Guatemala. In 1638, shipwrecked British sailors established the first known European settlement in Belize. During the next 150 years, the British established several more settlements in Belize. Spain did little to exercise its rule over the area, and Britain gradually gained control of it. In 1862, Britain named the area the Colony of British Honduras.

Britain made British Honduras a self-governing territory in 1964. George C. Price of the People's United Party (PUP) became prime minister. In 1973, British Honduras changed its name to Belize. Belize gained independence from Britain on Sept. 21, 1981. Price remained as prime minister until 1984, when elections brought the United Democratic Party (UDP) to office with Manuel Esquivel as prime minister. Elections of 1989 returned the PUP and Price to power. In 1993, the UDP won elections, and Esquivel became prime minister again.

Guatemala strongly protested Britain's granting of independence to Belize. Guatemala had gained independence from Spain in 1821, and from then until 1991, it claimed Belize. Gary S. Elbow

See also **Belize City; Belmopan**.

Belize City, *buh LEEZ* (pop. 48,400), is the largest city of Belize. It lies on the Caribbean Sea, at the mouth of a branch of the Belize River. See **Belize** (map). Belize City served as the capital of Belize until 1970, when Belmopan became the capital. Belize City is a center for the fishing industry and a shipping center. The city ships lumber, coconuts, bananas, oranges, sugar, and lobsters. About one out of four people in Belize lives in Belize City. The English settled Belize City in the 1600's. They came to the area to get lumber. Fort George, built in 1803, still stands there. In 1961, a hurricane destroyed most of Belize City. It killed more than 300 people. See also **Belmopan**. Gary S. Elbow

Bell is a hollow, metal vessel in the shape of a cup with a *clapper* (metal tongue) suspended inside. The bell rings with a clear, musical sound when the clapper strikes it. Bells vary in tone from high to low, according to their thickness and size. Sets of bells may be made, each bell having a different tone to correspond to the tones of the musical scale. Orchestra bells are made this way, except they are metal bars of various lengths that are struck with a small mallet to produce the sound. Bells serve many purposes, and their sound forms a familiar part of daily life. Church bells summon people to worship. Bells ring to announce important events such as 12 o'clock on New Year's Eve.

How bells are made. The bells used in churches and carillons are molded in a single piece from molten metal. *Bell metal,* as it is called, consists of a mixture of copper and tin. The usual proportions are 4 parts of copper to 1 of tin. Bell casting requires two molds. Metal shells form the basic shape of the bell. These shells are covered with clay or a molding mixture to form the finished molds for the exact shape of the bell. The inner mold forms the open space inside the bell. The outer mold shapes the outside of the bell. This mold contains holes that permit the escape of gases, which would otherwise leave bubbles in the bell. The liquid metal is poured between the two molds. After the metal cools and hardens, the bell is then removed from the

mold. A large bell may require several weeks to cool thoroughly.

Chimes and carillons. Chimes are metal tubes of varying lengths that hang from a metal frame. The most familiar chimes are orchestral chimes. There are seldom more than 12 chimes in a set, and each has a different pitch. The player strikes them with a leather-headed mallet to produce sound. *Carillons* (bells set together to play melodies) may have 70 or more bells. Carillons can be played by hand, but most are operated by electricity. The player sits at a keyboard which resembles that of an organ. As the performer presses a key, an electrical connection strikes a hammer against the proper bell to sound it. This art developed in the Low Countries, now Belgium, Luxembourg, and the Netherlands.

History. Bells, like many other musical instruments, developed in Asia. They were known in China from about 1500 B.C. Archaeologists have found a richly ornamented Assyrian bronze bell, used for ceremonial purposes, which dates from the 800's B.C.

In ancient Greece, the ringing of bells announced that freshly caught fish had arrived at the market. In times of war, bells were rung to warn people that enemies were approaching the gates of the city. In Rome, bells called the faithful to worship in the temples. Bell ringing also accompanied the funeral services of the Roman emperors. Later, Celtic tribes, who were famous for their metal-casting techniques, brought bells from Asia into Europe.

Bells were introduced into France in the mid-500's, and into England about 100 years later. One of the oldest bells in the British Isles is the *Bell of Saint Patrick's Will,* in Dublin. It is 6 inches (15 centimeters) high and 5 inches (13 centimeters) across. Legend says that it belonged to Saint Patrick.

Bell makers often put the year the bell was cast on the bell. A bell in Drohndorf, Germany, dates from 1098, and one in Pisa, Italy, is marked 1106. Bayeux, France, has a bell dated 1202, and one in Claughton, England, is from 1296.

Uses of bells. Bells have always been associated with religious services. Since about 400, Christians have used them to summon worshipers. Church bells often toll to announce a death. It became the custom by the 900's to hang church bells in special towers. A metal rod struck the bell to sound it. Often the bell was swung to make a metal clapper strike it. Most bell towers formed a part of the church building. Others stood apart. Most bell towers in Italy, called *campaniles,* stand apart. Edward Bok built *The Singing Tower,* a famous bell tower, at Mountain Lake, Fla.

Bells have served many other purposes. In England during the Middle Ages, a bell rung at evening announced the curfew (see Curfew). For many years, town criers rang bells to attract attention to their notices. In many countries, people used bells in case of fire, to call city council meetings, and to remind citizens of tax deadlines. In pioneer days in America, bells warned of Indian attacks. At sea, *buoys* (floating markers) sometimes carry bells to warn ships off dangerous coasts. Bell sounds mark the time on board ship (see Ship ([Nautical terms: Ship's bell]).

Bells have often been used in musical compositions. In 1791, Nicholas Dalayrac introduced bells in his opera *Camille.* Three years later, the Italian composer Luigi Cherubini followed his example in the opera *Elisa.* Many composers, including Richard Wagner, Gustav Mahler, and Richard Strauss, wrote parts for bells tuned to a specific pitch into their works. Real bells are usually too unwieldy and costly for orchestral uses, so they are often replaced by long metal tubes suspended from a frame and hit with a hammer.

Various kinds and pitches of handbells are also used together to produce music. Professional musicians or groups of students from music schools and universities arrange classical and popular music for bells. These *bell ringers* make tours and present musical programs to audiences. Handbells are common in Europe.

Famous bells. The most famous bell in America is the *Liberty Bell.* It pealed forth the news of the adoption

Burnished brass bell portraying the Hindu god Hanuman (1800's); Metropolitan Museum of Art, the Crosby Brown Collection of Musical Instruments, 1889

Temple bell from India

Brass ceremonial rattle with small bells (1800's); Metropolitan Museum of Art, Gift of Mrs. John Crosby Brown, 1909

African bells

Bronze bell (1800's); Metropolitan Museum of Art, the Crosby Brown Collection of Musical Instruments, 1889

Japanese temple bell

© Linda Kelly-Hasett from Caryle Calvin

Orchestra chimes

of the Declaration of Independence. Another famous bell, *Big Ben,* hangs in the Clock Tower of the Houses of Parliament in London. China's most famous bell is in Beijing. It weighs about 60 tons (54 metric tons) and was made about 1415. In Myanmar, there is a 97-ton (73-metric-ton) bell.

The largest and heaviest carillon in the world is in the Riverside Church in New York City. It has 74 bells and weighs 100 tons (91 metric tons). The carillon in the city of Mechelen, Belgium, is considered the world's finest. It has 45 bells. John H. Beck

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Big Ben	Carillon	Liberty Bell
Campanile	Chimes	Orchestra bells

Bell, Alexander Graham (1847-1922), a Scottish-born inventor and educator, is best known for his invention of the telephone. Bell was 27 years old when he worked out the principle of transmitting speech electrically, and was 29 when his basic telephone patent was granted in 1876.

The telegraph had been invented before Bell's time. Signals, music, and even voicelike sounds had been transmitted electrically by wire. But human speech had never been sent by wire. Many inventors were working to accomplish this, and Bell was the first to succeed.

Bell's great invention stemmed from his keen interest in the human voice, his basic understanding of acoustics, his goal of developing an improved telegraph system, and his burning desire for fame and fortune. Bell, a teacher of the deaf, once told his family he would rather be remembered as such a teacher than as the inventor of the telephone. But the telephone was of such great importance to the world that Alexander Graham Bell's name will always be associated with it.

His early life. Bell's family and education deeply influenced his career. He was born on March 3, 1847, in Edinburgh, Scotland. His mother, Elisa Grace Symonds, was a portrait painter and an accomplished musician. His father, Alexander Melville Bell, taught deaf-mutes to speak and wrote textbooks on speech. He invented "Visible Speech," a code of symbols that indicated the position of the throat, tongue, and lips in making sounds. These symbols helped guide the deaf in learning to speak. The boy's grandfather, Alexander Bell, also specialized in speech. He acted for several years and later gave dramatic readings from Shakespeare.

Young Alexander Graham Bell was named for his grandfather. He adopted his middle name from a friend of the family. His family and close friends called him Graham. He was a talented musician. He played by ear from infancy and received a musical education.

Bell and his two brothers assisted their father in public demonstrations of Visible Speech, beginning in 1862. Bell also enrolled as a student-teacher at Weston House, a boys' school near Edinburgh, where he taught music and speech in exchange for instruction in other subjects. He became a full-time teacher after studying for a year at the University of Edinburgh. He also studied at the University of London and used Visible Speech to teach a class of deaf children.

In 1866, Bell carried out a series of experiments to determine how vowel sounds are produced. He read a book on acoustics by the German physicist Hermann von Helmholtz, which described experiments in combining the notes of electrically driven tuning forks to make vowel sounds. It gave Bell the idea of "telegraphing" speech, though he had no idea about how to do it. But, this was the start of Bell's interest in electricity.

American Telephone & Telegraph Company

Alexander Graham Bell called Chicago from New York City in 1892 to demonstrate the use of the telephone to businessmen.

Bell took charge of his father's work while the latter lectured in the United States in 1868. Bell became his father's partner in London in the following year. He specialized in the anatomy of the vocal apparatus at University College in London at the same time.

Then disaster uprooted the Bell family. Graham's younger brother had died of tuberculosis, and his elder brother died from the same disease in 1870. The doctors gave warning that Graham, too, was threatened. His father sacrificed his career in London and in August 1870, moved the family to Brantford, Ontario, Canada, where he found during his travels what he considered a healthy climate. Graham soon recovered his health.

The Boston teacher. Sarah Fuller, principal of a school for the deaf in Boston, asked Melville Bell to show her teachers how to use Visible Speech in teaching deaf pupils to talk. Melville could not go but recommended his son. In 1872, young Bell opened a school for teachers of the deaf in Boston. The following year, he became a professor at Boston University.

Bell's instruction in Visible Speech and his lively mind won him many friends in Boston. One of these friends was the Boston attorney Gardiner Green Hubbard. Bell met Hubbard through his work with Hubbard's daughter Mabel, who as a child had been left deaf by scarlet fever. Hubbard was an outspoken critic of Western Union Telegraph Company. When he learned that Bell had been secretly working on improvements to the telegraph, Hubbard immediately offered him financial backing in the hope of outdoing Western Union.

Bell did not attempt to transmit speech electrically when he first began his experiments in 1872. He tried instead to send several telegraph messages over a single wire at the same time—an urgent need of the telegraph industry. In 1874, while visiting his father in Brantford,

Bell developed the idea for the telephone. When he returned to Boston, Bell continued his telegraphy experiments, but always with the idea of the telephone in mind.

Bell soon found that he lacked the time and skill to make all the necessary parts for his experiments. At Hubbard's insistence, he went to an electrical instrument-making shop for help. There, Thomas A. Watson began to assist Bell. The two men became fast friends, and Watson eventually received a share in Bell's telephone patents as payment for his early work.

The telephone. During the tedious experiments that followed, Bell reasoned that it would be possible to pick up all the sounds of the human voice on the harmonic telegraph he had developed for sending multiple telegraph messages. Then, on June 2, 1875, while Bell was at one end of the line and Watson worked on the reeds of the telegraph in another room, Bell heard the sound of a plucked reed coming to him over the wire. Quickly he ran to Watson, shouting, "Watson, what did you do then? Don't change anything."

After an hour or so of plucking reeds and listening to the sounds, Bell gave his assistant instructions for making a pair of improved instruments. These instruments transmitted recognizable voice sounds, not words. Bell and Watson experimented all summer, and in September 1875, Bell began to write the specifications for his first telephone patent.

The patent was issued on March 7, 1876. Three days later, Bell transmitted human speech for the first time. Bell and Watson, in different rooms, were about to try a new type of transmitter that Bell had briefly described in his patent. Then Watson heard Bell's voice saying, "Mr. Watson, come here. I want you!" Bell had upset the acid of a battery over his clothes, but he quickly forgot the accident in his excitement over the success of the new transmitter.

Bell demonstrated his telephones at the Centennial Exposition in Philadelphia in June 1876. One of the judges, the Emperor Dom Pedro of Brazil, was impressed by Bell's instruments. The British scientist Sir William Thomson (later Lord Kelvin) called the telephone "the most wonderful thing in America."

Bell and Watson gave many successful demonstrations of the telephone, and their work paved the way for commercial telephone service in the United States. The first telephone company, called the Bell Telephone Company, came into existence on July 9, 1877. Two days later, Bell married Mabel Hubbard, and the couple sailed to England to introduce the telephone there. The Bells returned home in 1878 and moved to Washington, D.C.

Bell did not take an active part in the telephone business. But he was frequently called upon to testify in lawsuits brought by men claiming they had invented the telephone earlier, including the American inventors Elisha Gray and Thomas Edison. Several suits reached the Supreme Court of the United States. The court upheld Bell's rights in all the cases.

His later life. Bell lived a creative life for more than 45 years after the invention of the telephone. He gave many years of service to the deaf and produced other communication devices.

The French government awarded Bell the Volta Prize of 50,000 francs in 1880 for his invention of the telephone. He used the money to help establish the Volta Laboratory for research, invention, and work for the deaf. There, he and his associates developed the method of making phonograph records on wax disks. The patents for the method were sold in 1886, and Bell used his share of the proceeds to establish the Volta Bureau, a branch of the laboratory, to carry on his work for the deaf. In 1890, Bell founded and financed the American Association to Promote the Teaching of Speech to the Deaf (now called the Alexander Graham Bell Association for the Deaf).

Bell developed an electrical apparatus to locate bullets in the body in a vain effort to save President James Garfield's life. President Garfield had been shot by an assassin in 1881. Tests on the president were unsuccessful because the doctors failed to remove the steel spring in Garfield's bed. Bell perfected an electric probe which was used in surgery for several years before the X ray was discovered. Bell also advocated a method of locating icebergs by detecting echoes from them. He worked on methods to make fresh water from vapor in the air for people adrift at sea in open boats. For 30 years, he directed breeding experiments in an attempt to develop a strain of sheep that would bear more than one lamb at a time.

Bell was interested in flying throughout his life. He helped finance American scientist Samuel P. Langley's experiments with heavier-than-air machines and used his influence in Langley's behalf. He conducted a long series of experiments with kites capable of lifting a person into the air. These experiments tested the lifting power of plane surfaces at slow speeds. In 1907, Bell helped organize the Aerial Experiment Association. This organization worked to advance aviation. In addition, Bell contributed to the establishment of *Science* magazine and helped organize the National Geographic Society.

Alexander Graham Bell became a citizen of the United States in 1882. He spent most of his later life at his estate on Cape Breton Island, Nova Scotia. He worked in his laboratory or sat at his piano playing old Scottish tunes. Bell died Aug. 2, 1922, at his Nova Scotia home.

David A. Hounshell

See also **Nova Scotia** (Places to visit); **Hydrofoil** (History); **Communication** (picture: Alexander Graham Bell).

Additional resources

Grosvenor, Edwin S., and Wesson, Morgan. *Alexander Graham Bell.* Abrams, 1997.

Joseph, Paul. *Alexander Graham Bell.* Abdo, 1997. Younger readers.

Mackay, James A. *Alexander Graham Bell: A Life.* Wiley, 1998.

Pasachoff, Naomi. *Alexander Graham Bell: Making Connections.* Oxford, 1996.

Bell, John (1797-1869), a prominent American statesman, was the Constitutional Union Party candidate for president in 1860. The party campaigned on the issue of national unity at a time when efforts to limit slavery threatened to drive the Southern States from the Union. Bell carried only the states of Kentucky, Tennessee, and Virginia.

Bell was born near Nashville. He became a noted lawyer in Tennessee and served as a United States representative from that state from 1827 to 1841. Bell was

speaker of the House in 1834 and 1835, secretary of war under President William Henry Harrison in 1841, and a U.S. senator from 1847 to 1859. Bell was a slaveowner, but he took some stands against the expansion of slavery to help preserve the Union. But when the Civil War began in 1861, Bell supported the Confederate States of America and retired from public life. Gabor S. Boritt

Bell Burnell, Jocelyn (1943-), is a British astronomer who was the first person to detect a *pulsar.* A pulsar is a rapidly spinning *neutron star,* a star made mainly of neutrons or perhaps of elementary particles called *quarks.* The pulsar sends out beams of radio waves and other electromagnetic radiation. The beams sweep over the earth at regular intervals.

Bell first observed a pulsar while a graduate student at the University of Cambridge in England in 1967. While using a new radio telescope, she noted pulses coming from an unknown source, later identified as a new type of star. Her observations, and further work with Cambridge astronomer Antony Hewish, proved the existence of neutron stars. Since the 1930's, astronomers had believed that neutron stars existed. The discovery of pulsars gave rise to many new ideas about the origin and development of stars.

Susan Jocelyn Bell was born in Belfast, Northern Ireland. She received a Ph.D. degree from the University of Cambridge in 1968. In 1986, she became senior scientific officer at the Royal Observatory in Edinburgh, Scotland.

Joanna M. Rankin

See also **Pulsar; Telescope** (Radio telescopes).

Bell Rock. See **Inchcape Rock.**

Bell tower. See **Campanile.**

Bella Coola Indians live in western Canada. Most Bella Coola make their homes in the village of Bella Coola, which lies along the Bella Coola River in British Columbia. Many of them work for canneries, fisheries, or logging companies. Others have jobs in such cities as Vancouver and Victoria, British Columbia.

Most Bella Coola speak English, have attended Canadian schools, and live much like other Canadians. However, they still follow a number of traditional customs and maintain a distinct ethnic identity. They elect a governing body called a *band council* to administer matters concerning the Bella Coola band.

The ancestors of the modern Bella Coola were prosperous, seafaring fisherfolk and woodworkers for thousands of years. The Pacific Ocean and the region's rivers provided abundant resources. The Indians trapped, speared, netted, and hooked fish. Their most important catches included eulachon, which provided oil, and salmon, which were eaten fresh or preserved by drying or smoking. They also gathered shellfish and seaweed. The Bella Coola built summer and winter villages of large plank houses on the banks of rivers and inlets.

The Bella Coola were highly conscious of social rank. Wealthy, socially prominent individuals held feasts called *potlatches,* at which they gave their guests valuable gifts. Religious life centered around ceremonial dances and performances given by secret societies, and around potlatches. Woodworkers and other Bella Coola artists produced elaborate costumes, masks, and settings.

The first known contact between whites and the Bella Coola occurred in 1793, when Alexander Mackenzie, a Canadian fur trader and explorer, visited the Indians' territory. At that time, there were at least 2,000 Bella Coola living in about 45 communities. They were divided into three ethnic and dialect groups, each of which spoke a different dialect of an Indian language called Coast Salish. Outbreaks of smallpox and years of warfare with neighboring Indians reduced the population to about 250 by 1929. Today, there are about 600 Bella Coola.

Robert S. Grumet

Belladonna, *BEHL uh DAHN uh,* is a bushy plant that supplies several drugs. The most important drug obtained from the plant is *atropine* (see **Atropine**). Belladonna is sometimes called *deadly nightshade* to distinguish it from *common,* or *black,* nightshade, which is not so dangerous. It grows in Europe and Asia. Some is now raised in the United States.

Belladonna bushes are often grown in gardens for their beauty. They are from 2 to 3 feet (61 to 91 centimeters) high and have drooping, bell-shaped flowers that are blue-purple or dull red. People have died from eating the berries, which contain the belladonna drugs. Vinegar is a simple first-aid remedy for belladonna poisoning, but a physician should be called at once.

Belladonna drugs are taken from the roots and leaves, but all parts of the plant contain the drugs. They are an important antidote for poisoning with certain insecticides and mushrooms. They also are sometimes used to relieve colic and various intestinal troubles. Ophthalmologists sometimes use belladonna drugs to relax eye muscles and to cause the pupil to expand. The drugs should be used only under the direction of a physician.

Frank Welsch

Scientific classification. Belladonna is in the nightshade family, Solanaceae. Its scientific name is *Atropa belladonna.*

Bellamy, *BEHL uh mee,* **Edward** (1850-1898), an American author, wrote *Looking Backward* (1888), one of the most popular and influential novels of the 1800's. The hero of the story is a young Boston man who falls into a hypnotic sleep in 1887 and awakens in 2000. He finds that the United States has become a socialist economic state that has eliminated all competition and private enterprise. The new order has produced an ideal society in which the people are happy, healthy, and well educated. All the people are equal economically. Thus, poverty, crime, and war have disappeared.

In *Looking Backward,* Bellamy attacked the inequality and injustices that he saw in the capitalist society of his time. The success of the book led to the establishment of more than 150 clubs that promoted social reform and spread Bellamy's ideas.

Bellamy was born in what is now Chicopee, Massachusetts. He wrote much other fiction, but none of his other works achieved the fame of *Looking Backward.*

Bert Hitchcock

Bellarmine, *BEHL ahr mihn* or *BEHL ahr meen,* **Saint Robert Francis Romulus,** *RAHM yoo luhs* (1542-1621), an Italian Jesuit theologian, defended the rights of the Roman Catholic Church in an age of absolutism. He joined the Jesuit order in 1560, and taught theology at the University of Louvain from 1570 to 1576. He was made a cardinal in 1599, and archbishop of Capua in 1602. Bellarmine wrote many works. He was one of the key figures in the defense of the Roman Catholic Church against the growing absolutism of kings and against

Protestantism. He was *canonized* (proclaimed a saint) by Pope Pius XI in 1930. His feast day is May 13. He was born at Montepulciano, Italy. Marvin R. O'Connell

Bellay, Joachim du. See **Du Bellay, Joachim.**

Bellbird is a medium-sized bird that lives in Central and South America. Bellbirds probably produce louder calls than any other type of bird. The *white bellbird* sings one note that sounds like a drawn-out chime. The call of the *bearded bellbird* sounds like a blacksmith's hammer on an anvil. During the mating season, male

H. Rivarola, Bruce Coleman Ltd.

A bellbird produces an unusually loud call.

bellbirds call to females from established perches. Two species of birds found in Australia and New Zealand are also called *bellbirds.* They are not related to American bellbirds. David M. Niles

Scientific classification. The American bellbirds are in the genus *Procnias* in the family Cotingidae.

Bellflower is the common name of a group of wild and cultivated plants, most of which have bell-shaped blossoms. Most species bloom in late spring or summer and have purple, blue, pink, or white blossoms. Some species grow as tall as 6 feet (1.8 meters), but others creep along the ground. Bellflowers grow mainly in the Northern Hemisphere and are especially plentiful in the Mediterranean region. In the United States, popular cultivated bellflowers include *Canterbury bells, harebells* (or *bluebells*), and *peach bells* (or *peach-leaved bellflowers*). The roots and leaves of one bellflower, *rampion,* may be cooked and eaten as a vegetable.

Margaret R. Bolick

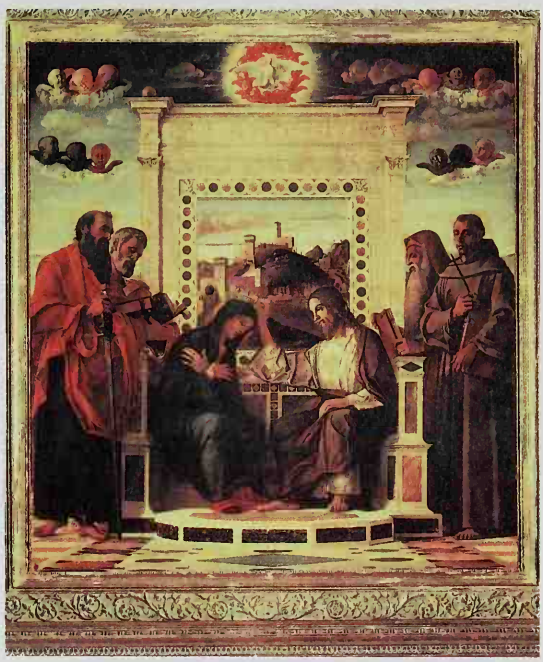
Scientific classification. Bellflowers belong to the bellflower family, Campanulaceae. Bellflowers make up the genus *Campanula.*

Bellini, *behl LEE nee,* **Gentile,** *jehn TEE leh* (1429?-1507), was an important painter in Venice during the Italian Renaissance. Gentile is best known for his paintings that captured the appearance of Venice in his day. He is also remembered for the large, decorative works he did for Venice's *scuole,* semireligious associations of pious laymen dedicated to charitable works. Gentile painted religious processions through the streets of Venice and episodes from the lives of early Christian saints. He focused on urban settings of the time, and these paintings serve as valuable portrayals of life in a city during the late 1400's.

In 1479, Gentile was sent to Constantinople (now Istanbul) to paint the portrait of Sultan Mehmet II. This portrait, as well as other works from this visit, show how Gentile adapted his Italian Renaissance style to the Islamic painting tradition of using broad, flat areas of pattern and color. Donald Rabiner

Bellini, *behl LEE nee,* **Giovanni,** *joh VAHN nee* (1432?-1516), was the greatest member of the Bellini family of painters in Venice during the Italian Renaissance. His most important contribution to art lay in his experimentation with the use of color and atmosphere in oil painting. His poetic landscapes influenced Giorgione, Titian, and other Venetian painters of the 1500's. Giovanni also helped further the development of a type of painting called *sacra conversazione* (holy conversation), which features the Madonna and Child in an interior or landscape setting with two or more saints.

Giovanni's early works reflect clear, crisply defined forms. By the 1470's and 1480's, he began to use warmer



Coronation of the Virgin (about 1470), an oil painting on wood panel; Museo Civico, Pesaro, Italy (SCALA/Art Resource)

A Giovanni Bellini altarpiece shows the balanced composition and use of perspective found in many of his paintings.

colors, softer forms, and more atmosphere. Through the use of clear, slow-drying oil paints, Giovanni created deep, rich colors and detailed shading. Giovanni's interest in landscapes is in keeping with the Venetian fascination with the natural world. One of his finest works of this type is the *St. Francis in Ecstasy* (see **Francis of Assisi, Saint**). Donald Rabiner

Bellini, *behl LEE nee,* **Jacopo,** *YAH koh poh* (1400?-1470?), was one of the founders of the Renaissance style of painting in Venice and northern Italy. The style reached its maturity in the late 1400's in the works of his sons Gentile and Giovanni and his son-in-law Andrea Mantegna. Jacopo was particularly interested in linear perspective. This was a mathematical system that en-

abled him to create convincing illusions of three-dimensional space and solid shapes on flat wooden panels. Most of the paintings for which he was best known in his day have been lost. His surviving works show how he accommodated linear perspective to the decorative patterns and rich colors of Venetian painting.

In spite of his importance as a painter, Jacopo is best known today for his drawings. They range from simple sketches to elaborate compositions that reflect his fascination with the illusion of space. Donald Rabiner

Bellini, *behl LEE nee,* **Vincenzo,** *veen CHEHN tsoh* (1801-1835), was an Italian opera composer. His operas are noted for the emotional nature of their melodies, expertly created for highly trained singers.

Bellini was born in Catania, Sicily. His first opera and only comedy, *Adelson e Salvini,* was staged in 1825. The success of his next opera, *Bianca e Gernando* (1826), earned him a commission to compose for Italy's leading opera house, La Scala, in Milan. Bellini then began a famous collaboration with Felice Romani, who wrote the *librettos* (words) for seven of his operas. The most popular are *La Sonnambula* (1831) and *Norma* (1831). Their success placed Bellini with Gioacchino Rossini and Gaetano Donizetti as the foremost opera composers of the day. *I Puritani,* one of Bellini's finest works, was produced the year he died. Charles H. Webb

Belloc, *BEHL uhk,* **Hilaire,** *hih LAIR* (1870-1953), was a British novelist, essayist, historian, and poet. His many books and essays reflect his political conservatism and devotion to the Roman Catholic Church. Today, his reputation rests mostly on his light verses for children, including *The Bad Child's Book of Beasts* (1896) and *Cautionary Tales* (1907), and for his travel memoir, *The Path to Rome* (1902).

Belloc was born in St. Cloud, a suburb of Paris. His full name was Joseph Hilaire Pierre Belloc. He grew up in England, became a British citizen in 1903, and served as a member of Parliament from 1906 to 1910. He withdrew from politics in 1911 to write and publish political articles. Belloc and his friend G. K. Chesterton, also an English writer, edited a weekly political newspaper in which they promoted their Catholic beliefs and conservative ideas, with an emphasis on economic reform. Much of Belloc's later work was designed to correct what he felt was an overly Protestant slant in the writing of British history. Garrett Stewart

Bellow, Saul (1915-), is an American author. In 1976, Bellow was awarded the Nobel Prize for literature. He also received the 1976 Pulitzer Prize for fiction for *Humboldt's Gift.* Three of his novels won National Book Awards—*The Adventures of Augie March* in 1954, *Herzog* in 1965, and *Mr. Sammler's Planet* in 1971.

Bellow's first two novels are dark, almost grim. *Dangling Man* (1944) describes how World War II embitters its young hero and arrests his intellectual and spiritual growth. *The Victim* (1947) dramatizes the psychological destructiveness of anti-Semitism for both persecutors and victims. In *The Adventures of Augie March* (1953), Bellow more fully expressed his serious concerns in the exuberant, comic style that characterizes his best fiction. March is half rogue and half hero. He zestfully keeps one step ahead of those who want to trap him into their own narrow value systems. Henderson, the middle-aged hero of *Henderson the Rain King* (1959), seeks truth among African tribes.

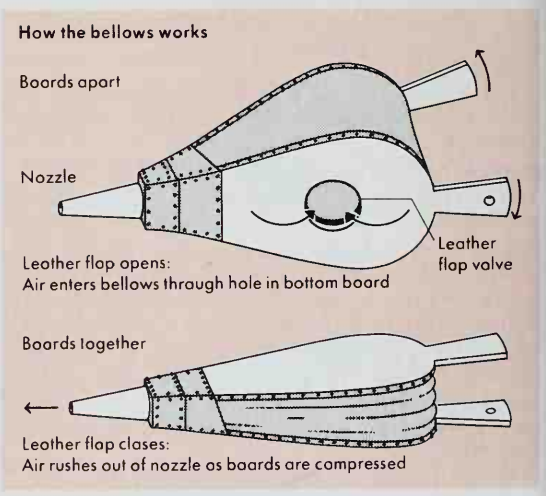
In his next three novels, Bellow turned from boisterous heroes, such as March and Henderson, to older and more thoughtful characters. The hero of *Herzog* (1964) is a literature scholar. His guilt, marriage problems, and dissatisfaction with the United States in the 1950's drive him to take an impossibly idealistic view of the world. In *Mr. Sammler's Planet* (1970), an elderly Jewish scholar confronts the violence and tensions of modern life in New York City. *Humboldt's Gift* (1975) is built on the relationship between a middle-aged author, Charlie Citrine, and a gifted but eccentric poet. Citrine, like Herzog, gains wisdom only after financial and romantic misadventures. *The Dean's December* (1982) deals with an American college dean and his reflections on the problems of modern life. *More Die of Heartbreak* (1987) also examines modern problems of alienation and loneliness. The central character in *Ravelstein* (2000) resembles a friend of Bellow's, conservative critic Allan Bloom.

Bellow was born in Lachine, a suburb of Montreal. When he was 9 years old, his family moved to Chicago, a city that he has portrayed vividly in several novels. Bellow also wrote three novellas, *Seize the Day* (1956), *A Theft* (1989), and *The Bellarosa Connection* (1989). His other works include a book of political observation, *To Jerusalem and Back* (1976), as well as criticism, drama, and short stories. *It All Adds Up* (1994) is a collection of essays, sometimes autobiographical, about writing and culture. Victor A. Kramer

Additional resources

Bellow, Saul. *Conversations with Saul Bellow.* Univ. Pr. of Miss., 1994.
Hyland, Peter. *Saul Bellow.* St. Martin's, 1992.

Bellows is a device that produces wind by sucking air through one or more valves and then pumping it out. A *simple bellows* has a single air chamber, formed by two boards and soft leather sides. This bellows expels strong puffs of air through a nozzle. A hand-pumped simple bellows is commonly used to make wood in a fireplace burn intensely. A *double bellows* has two chambers and produces a continuous flow of air. More complex bellows help produce sound in such musical instruments as accordions and pipe organs.



Oil portrait (1924) by George Bellows. Yale University Art Gallery, New Haven, Conn. Bequest of Steven Carlton Clark.

George Bellows's painting *Lady Jean* shows his daughter dressed in adult clothes. He made fine portraits of his family.

Bellows, George Wesley (1882-1925), was a leading American artist of the early 1900's. He is noted for paintings of boxing matches, the New York City area, and seascapes, and for portraits of his wife and daughters.

Bellows was born in Columbus, Ohio. He moved to New York City in 1904, where he studied painting with the painter and teacher Robert Henri. Bellows's studio was near Tom Sharkey's club. There, Bellows saw the professional prize fights that inspired two of the most powerful paintings ever done of fighters in action—*Both Members of This Club* (1909) and *Stag at Sharkey's* (1909). Bellows often went to Long Island to paint the sea in its harshest moods. His many paintings of his family show his ability to depict character and mood. He created lively views of New York City in a rich, thickly textured style. He also was largely responsible for the revival of lithography in the United States. Sarah Burns

Bell's palsy, *PAWL zee,* is a disease that paralyzes one side of the face. A person who has Bell's palsy cannot wrinkle the forehead or close the eye on the affected half of the face. The mouth sags on one side. With effort, the victim can move the facial muscles on the healthy side. But the face is distorted because the muscles on the other side cannot be moved.

The symptoms of Bell's palsy appear suddenly in most cases. The victim may feel some pain for one or two days before they occur. But the paralysis itself is painless. Most victims lose the sense of taste on one side of the tongue. The eye on the paralyzed side becomes dry. Sounds may seem extremely loud at times.

Bell's palsy is caused by a sudden swelling of the main motor nerve on one side of the face. A bony canal surrounds this nerve. The swollen nerve presses against its canal, causing the nerve to function improperly. The swelling may be caused by a virus, possibly a *herpesvirus* (see **Herpesvirus**). However, not all doctors agree on how the disease should be treated.

More than 90 percent of the victims of Bell's palsy recover in several weeks, even without treatment. In some cases, the symptoms become permanent. In its early stages, Bell's palsy can be treated with drugs called steroid hormones.

Bell's palsy is named after Sir Charles Bell, a British physician. In 1829, Bell described the function of the facial nerves. Jerome C. Goldstein

Belmopan *BEHL moh PAN* (pop. 3,500), is the capital of Belize. It lies about 35 miles (55 kilometers) inland from the Caribbean Sea. For the location of Belmopan, see **Belize** (map). Belmopan became the capital in August 1970, when Belize was still a British dependency. The city's inland location helps protect it from damage caused by hurricanes and flooding that strike Belize City, the former capital, on the coast.

Construction of Belmopan, a planned city, began in the late 1960's. The city's first structures were government buildings and homes for government workers. Since Belize gained independence in 1981, Belmopan has grown slowly in size and importance.

The name *Belmopan* comes from *Belize,* the name of the country and its chief river, and *Mopan,* the name of a Mayan Indian tribe. As early as the A.D. 500's, the Mayan civilization flourished in the area that is now Belize. Mayan designs decorate several of the city's government buildings. Nathan A. Haverstock

Belo Horizonte, *BAY loh HAWR uh ZAHNT ee* (pop. 2,145,908; met. area pop. 3,615,234), is the third largest city in Brazil. Only São Paulo and Rio de Janeiro have more people. Belo Horizonte is also an industrial center and the capital of the state of Minas Gerais. It lies in southeastern Brazil (see **Brazil** [political map]). Belo Horizonte, which means *Beautiful Horizon,* is named for the scenic, hilly area that surrounds it.

Belo Horizonte was founded in 1897. The city was laid out with wide, tree-lined streets and a central square. Belo Horizonte has many attractive buildings. It also has two universities. Industries in Belo Horizonte produce steel from nearby iron mines and process food from farms in the area. The city's industries also manufacture such products as cement, textiles, and automobiles.

J. H. Galloway

Belsen. See Bergen-Belsen.

Beluga. See Whale (Belugas and narwhals).

Bemba is a term used to describe the language and culture of a large ethnic group in Central Africa. The Bemba language and culture are both called *Icibemba.* The name for the people who belong to this ethnic group is *Ababemba.* The traditional territory of the Bemba people, in northern Zambia, is called *Ulubemba.*

The Bemba language belongs to the Bantu family, which includes hundreds of other African languages, such as Swahili and Zulu. Bemba is the most widely spoken language in Zambia. About 4 million people speak Bemba or related dialects as their first language. Many other people speak it as a second or third language.

Most Bemba people in rural areas are farmers. They grow cassava, maize, millet, peanuts, sweet potatoes, and other crops. Fishing and occasional hunting add to their diet. In cities, Bemba people work in a variety of professions. Bemba families are *matrilineal* (related through the female line). Many Bemba families live as a large *extended family,* in which parents, children, grandparents, and other relatives share a home. The extended family plays a major role in people's lives, providing security and help with farm and household chores.

The Bemba people were once part of the ancient Luba Empire in what is now Congo (Kinshasa). They migrated to northern Zambia in the mid-1600's. The Bemba *Chitimukulu* (paramount chief) is the traditional ruler within Bemba territory. Today, the Chitimukulu also has a strong advisory role within the Zambian national government. Debra Spitulnik and Alexander Raymond Makasa Kasonde

See also **Bantu; Luba; Zambia.**

Bemelmans, *BEHM uhl muhnz,* **Ludwig** (1898-1962), was an American author and artist. He became best known for his children's books, especially six picture books about a young girl in Paris named Madeline. Bemelmans won the 1954 Caldecott Medal for his charming and colorful illustrations for *Madeline's Rescue* (1953). He began the series with *Madeline* (1939).

Bemelmans was born in a section of the Tyrol province of Austria now part of Italy, and moved to the United States in 1914. He became a U.S. citizen in 1918. Bemelmans also wrote stories and novels for adults. His nonfiction for adults includes a humorous autobiographical account of his experiences in the U.S. Army, *My War with the United States* (1937). A selection of his writings was published in 1985, after his death, as *Tell Them It Was Wonderful.* Jill P. May

Ben Bella, Ahmed (1919-) was the first president of the Republic of Algeria. He helped lead the revolt that freed Algeria from French rule. He served as president from 1963 to 1965, when he was overthrown by the army commander, Houari Boumedienne. Ben Bella was then held prisoner by the Algerian government until 1980, following Boumedienne's death in 1978.

Ben Bella was born in Marnia (now Maghnia), Algeria. He served in the French Army during World War II (1939-1945). He later became a leader in the Algerian independence movement. In 1949, he led a raid on the Oran post office and stole more than 3 million francs to help finance the movement. The French jailed him, but he escaped. In 1954, Ben Bella helped found the Algerian National Liberation Front (FLN). The French recaptured him in 1956. They released him in March 1962. In July, France gave Algeria its independence. Ben Bella then took control of the country. He was elected president in 1963. Kenneth J. Perkins

See also **Algeria** (Independence).

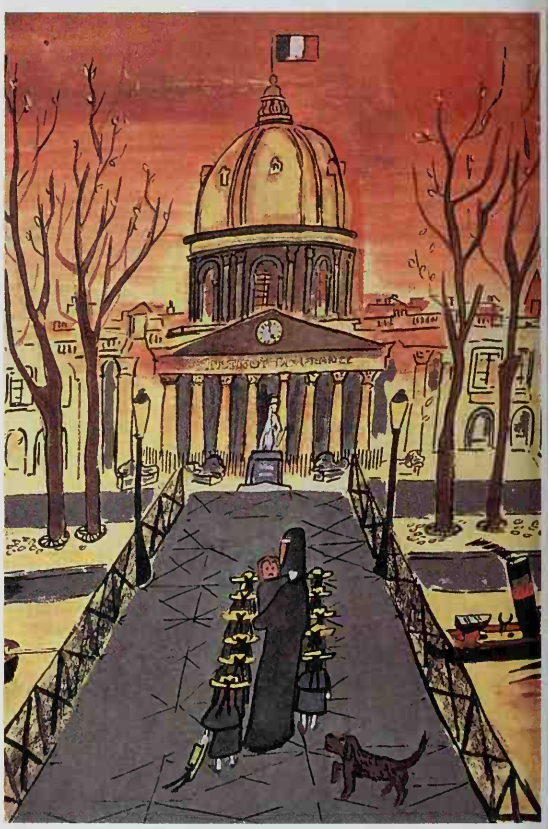
Ben-Gurion, *behn GOO rih uhn,* **David** (1886-1973), served as Israel's first prime minister after it became independent in 1948. He served as prime minister and minister of defense from 1948 to 1953 and from 1955 to 1963.

During the Suez crisis of 1956, Ben-Gurion ordered the Israeli invasion of the Gaza Strip and Sinai Peninsula. Later, Israeli forces withdrew at the request of the United Nations.

Ben-Gurion was born David Green in Płońsk, Russia (now in Poland). He settled in Palestine in 1906. By 1919, he was a Zionist leader, working for creation of a Jewish state in Palestine (see **Zionism**). In 1930, he founded the Mapai (Israel Workers' Party). He was a secretary-general of the *Histadrut* (General Federation of Labor) from 1921 to 1935.

As chairman of the Executive of the Jewish Agency for Palestine from 1935 to 1948, Ben-Gurion directed all Jewish affairs in the country. His activities ranged from land development and settlement of immigrants to secret activities against Arabs and the British. Ben-Gurion retired in 1963. Ellis Rivkin

See also **Israel** (History).



Viking Press

A Ludwig Bemelmans drawing from his book *Madeline's Rescue,* the 1954 Caldecott Medal winner, shows Madeline and 11 other little girls taking their daily walk in Paris with their teacher.

Additional resources

Silverstein, Herma. *David Ben-Gurion.* Watts, 1988.
Zweig, Ronald W., ed. *David Ben-Gurion: Politics and Leadership in Israel.* F. Cass, 1991.

Ben Nevis, *NEE vihs* or *NEHV ihs,* is the highest mountain in the United Kingdom. The mountain is in western Scotland, 7 miles (11 kilometers) east of Fort William. Ben Nevis rises 4,406 feet (1,343 meters) above sea level. A cliff 1,500 feet (457 meters) high is on the northeastern slope. A. S. Mather

Benares. See Varanasi.

Benavente, *bay nah VAYN tay,* **Jacinto,** *hah THEEN toh* (1866-1954), was the outstanding Spanish playwright of the early 1900's. He won the Nobel Prize for literature in 1922. His plays reveal a skillful use of dialogue, a sense of irony, and psychological insight into his characters. He excelled in writing farces, satirical comedies, and plays for children. One of his characters says, "Life is a comedy, and it is foolish to try to make it a drama." His masterpiece, *The Bonds of Interest* (1907), ridicules self-seeking social types of Madrid for their worship of wealth and status. His other important plays include the rural dramas *Señora Ama* (1908) and *The Passion Flower* (1913). Jacinto Benavente y Martinez was born in Madrid. He wrote more than 80 plays. David Thatcher Gies

Bench mark is a permanent and recognizable point that lies at a known elevation. A bench mark may be an existing object, such as the top of a fire hydrant. In other cases, surveyors bury a concrete post in the ground. A brass plate on top serves as the bench mark.

Surveyors and engineers use bench marks to find the elevation of objects. They also use bench marks to lay out roads, bridges, and other structures at a predetermined elevation. They determine the elevation by reading through a level telescope the distance the point lies above some already established bench mark. The elevation of a new point may be recorded, and the point then becomes another bench mark. Howard Turner

Bendix, Vincent (1882-1945), was an American inventor. He became known for his invention of the Bendix drive, a practical electric starter drive which helped promote the use of electric starting motors in automobiles. He combined various companies into the Bendix Aviation Corporation (now a part of Allied-Signal Inc.). The corporation's products included automotive and aircraft parts. In 1942, Bendix resigned from the corporation. Later, he founded Bendix Helicopters, Inc. He also founded the Bendix Transcontinental Air Race and donated the Bendix trophy. Bendix was born in Moline, Illinois. William H. Becker

Bends is a painful and dangerous condition caused by the formation of gas bubbles in the bloodstream and body tissues. It can occur when the air pressure surrounding the body decreases too rapidly. Bends is also called *decompression sickness* or *caisson disease.* It is most common among underwater divers and people who work in construction *caissons* (see Caisson). Such people may get bends if they return too quickly to the water surface or ground level. People in aircraft also may experience bends if pressurization in the cabin fails.

When air pressure drops too rapidly, nitrogen that was in solution in body fluids comes out of solution and forms bubbles. The bubbles stretch or break tissues or impair the circulation of blood through capillaries. Common symptoms of bends include pain in the joints of bones, itching or tingling of the skin, breathing problems, and partial or total paralysis. Less common symptoms include dizziness, nausea, vomiting, convulsions, and coma. Bends can be fatal in some cases.

Astronauts who perform activities outside their spacecraft wear special suits that enclose only a low pressure of gas. Before such extravehicular activity, astronauts breathe pure oxygen for three or four hours to allow nitrogen to leave the body. This reduces the chances of getting bends during the activity. Similarly, caisson workers and divers may breathe pure oxygen before and during their ascent to the surface.

Bends is treated by increasing the air pressure, usually in a sealed pressure chamber. Increasing the pressure compresses the nitrogen bubbles and causes some nitrogen to go back into solution in body fluids. The pressure is slowly lowered so that the nitrogen leaves the body without excessive bubbling. K. E. Money

See also Hyperbaric oxygen therapy.

Benedict XV (1854-1922) was elected pope of the Roman Catholic Church in 1914. His reign was dominated by World War I (1914-1918) and by a conflict with the Kingdom of Italy. This conflict, called the *Roman question,* concerned the status of Rome after Italian troops occupied the city in 1870, thus ending papal *temporal* (nonreligious) power there.

During the war, Benedict tried to maintain a strict neutrality between the opposing Allies and Central Powers. In the Treaty of London in 1915, the Allies secretly agreed with Italy to exclude the pope from peace negotiations to prevent him from introducing the Roman question. In 1917, Benedict submitted a seven-point peace plan, but both warring sides rejected it.

After the war, Benedict called for international reconciliation and gave general approval to the establishment of the League of Nations. He encouraged the United States Catholic bishops to found the National Catholic Welfare Council (now the National Conference of Catholic Bishops) in 1919. This organization represents Catholic interests in the United States.

In 1917, Benedict issued the Code of Canon Law. The code was the first complete collection of laws governing the entire church. Much of the code had been completed during the reign of the previous pope, Pius X.

Benedict was born in Pegli, near Genoa, Italy. His given and family name was Giacomo Della Chiesa. He was ordained a priest in 1878 and was trained for papal diplomatic service. Benedict was active in church diplomacy from 1882 until his appointment as archbishop of Bologna in 1907. He was named a cardinal in 1914, three months before his election as pope. Gerald P. Fogarty

Benedict, Ruth Fulton (1887-1948), was an American anthropologist. She made important contributions to the understanding of human culture in relation to the formation of personalities in different societies. She advised the United States government on Japanese culture in World War II (1939-1945). Her writings include *Patterns of Culture* (1934), *Race, Science, and Politics* (1940), and *The Chrysanthemum and the Sword: Patterns of Japanese Culture* (1946). She was born in New York City. David B. Stout

Benedict of Nursia, Saint (480?-547?), was the father of Christian monasticism in the West. He is best known

as the author of a *rule* (set of guidelines for monastic living). His rule emphasized a humane, moderate program of prayer, sacred readings, and manual labor. The simplicity and flexibility of the rule helped it become the most popular rule followed by monks from the 800's on.

The only source for the life of Benedict is the *Dialogues* (593-594), written by Pope Saint Gregory the Great. According to Gregory, Benedict was born in Norcia, Italy, near Rome. He studied in Rome but left there at the age of about 20 to lead a solitary religious life in a cave near Subiaco in central Italy. His piety soon attracted other young men, and he gradually organized them into 12 small monastic communities. Benedict left Subiaco with some of his followers and went to Monte Cassino about 525 (see **Monte Cassino**). There he established a great monastery and wrote his rule. His feast days are March 21 and July 11. Richard R. Ring

See also **Benedictines; Monasticism** (Christian monasticism).

Benedictines are Christian men and women who live according to the *rule* (guidelines for monastic living) written by Saint Benedict of Nursia in the early 500's. Most Benedictines are members of the Roman Catholic Church, but there are also Anglican and Lutheran Benedictine communities.

After a training period called a *novitiate,* Benedictines take perpetual vows of *obedience* to the rule and the abbot or abbess. They also take vows of *conversion of life* and *stability,* in which they promise to remain within the monastery where they completed their novitiate. After taking these vows, they become *professed* (lifetime) Benedictines. Some Benedictines, especially nuns, are *cloistered.* They take *solemn vows* to lead a life of prayer and contemplation within the monastery. Others take *simple perpetual vows.* They are not cloistered, but teach, perform social work, and serve as missionaries. Other Benedictines, called *Benedictine oblates,* are lay people who promise to live a spiritual life outside the monastery. The focus of Benedictine life is the celebration of the *Divine Office,* observed at certain times of the day. The Divine Office consists of psalms, hymns, and Scripture readings. Critically reviewed by E. Rozanne Elder

See also **Benedict of Nursia, Saint; Religious life** (Religious life in the Middle Ages).

Benefit-cost analysis. See Cost-benefit analysis.

Benelux, *BEHN uh luhks,* is an economic union formed by Belgium, the Netherlands, and Luxembourg. The term *Benelux* is made up of the first letters in each country's name. Benelux was organized in 1948 to create a common foreign trade policy by permitting the free movement of goods, workers, services, and capital between the countries.

Benelux began as a customs union. The members abolished custom duties among themselves and set a single external tariff. By 1956, over 95 percent of trade among the countries was free from all controls. An economic union was created by the Benelux Treaty in 1958 and came into force in 1960. The treaty made Benelux a single trading unit in January 1961, when trading with outside countries. Roma Dauphin

Beneš, *BEHN ehsh,* **Eduard,** *EH du AHRT* (1884-1948), was cofounder of Czechoslovakia with Tomáš Masaryk in 1918 (see **Masaryk** [Tomáš]). During World War I (1914-1918), while his country was part of the Austro-Hungarian empire, Beneš helped set up a Czechoslovak government in Paris. After the war, he served as foreign minister of Czechoslovakia from 1918 to 1935. He then succeeded Masaryk as president. He gave in to German demands for parts of Czechoslovakia in 1938 under pressure from the British and French. During World War II (1939-1945), Beneš headed the Czechoslovak government-in-exile in London. He was forced to give the Czechoslovak province of Ruthenia to the Soviet Union after the war. He permitted the Czechoslovak Communists to establish a dictatorship in 1948 rather than risk civil war. Beneš was born on May 28, 1884, in Kožlany, near Rakovník, in what is now the Czech Republic. R. V. Burks

Benét, *beh NAY,* **Stephen Vincent** (1898-1943), was an American poet and fiction writer. Benét's interest in American history and folklore, in addition to his interest in the ballad form, influenced his major work, *John Brown's Body* (1928). Benét received the 1929 Pulitzer Prize for poetry for this epic poem.

In *John Brown's Body,* Benét tried to give a full picture of the American Civil War (1861-1865). He dramatized battlefield scenes and portrayed the political events that led to the war. Early in the poem, the reader is taken back to the beginnings of the slave trade in the 1600's in America. The war itself is seen through the eyes of several characters, including a Southern belle, a runaway slave, an abolitionist from New England, and a Pennsylvania farmer who takes part in the Battle of Gettysburg.

Benét won the 1944 Pulitzer Prize for poetry for *Western Star* (1943), which describes the settling of the Plymouth and Jamestown colonies. The poem was part of an unfinished epic about the settling of America. Benét also wrote novels and short stories. His story "The Devil and Daniel Webster" (1937) is a fantasy that combines a folktale with New England history. Benét was born on July 22, 1898, in Bethlehem, Pennsylvania. Bert Hitchcock

Benét, *beh NAY,* **William Rose** (1886-1950), was an American poet, critic, and editor. He found material for some of his poems in American folklore and often used the ballad form. Benét won the 1942 Pulitzer Prize for poetry for his autobiographical verse narrative *The Dust Which Is God* (1941).

Benét was born on Feb. 2, 1886, in New York City. His brother was the noted poet Stephen Vincent Benét. In 1923, William married the American poet Elinor Wylie (see **Wylie, Elinor**). After her death, he edited her *Collected Poems* (1932) and *Collected Prose* (1933). In 1924, Benét helped found *The Saturday Review of Literature* (later *The Saturday Review*). Benét was the first editor of *The Reader's Encyclopedia* (1948). Bert Hitchcock

Bengal, *behn GAWL* or *BEHN guhl,* is a region in Asia. It includes the Indian state of West Bengal and the neighboring independent nation of Bangladesh (see **India** [political map]). Much of Bengal consists of farmland, but the region also has large cities—including Kolkata, India; and Dhaka, Bangladesh. Products of the region include coal, cotton, jute, rice, sugar, and tea.

In 1757, the British East India Company captured Bengal from the Mughal rulers of India. The western part of Bengal became an Indian state in 1947, when India became an independent nation. The eastern part was made a province of the newly created nation of Pakistan. In 1971, this province became the independent nation of

Bangladesh. For more information, see **Bangladesh** (History); **Pakistan** (History). Robert I. Crane

Bengal, Bay of. See **Bay of Bengal.**

Bengalis. See **Bangladesh** (Population and ancestry).

Benghazi, *behn GAH zee,* or, in Arabic, *Banghazi* (pop. 368,000), is the second largest city of Libya. Only Tripoli, the country's capital, has a larger population. Benghazi is a port on the Mediterranean Sea. The city serves as the commercial center of eastern Libya. For location, see Libya (map). Benghazi was part of the Ottoman Empire from the mid-1500's to 1911. Italy controlled it from 1911 until World War II (1939-1945). British troops captured the city during the war. Libya became an independent nation in 1951. L. Carl Brown

Benin, *beh NEEN,* is a country on the west coast of Africa. Long and narrow, Benin extends 415 miles (668 kilometers) inland from the Gulf of Guinea. Most of the people of Benin are farmers.

Benin was formerly a territory in French West Africa. It became independent in 1960. The country's name in French, the official language, is République du Benin. The nation was called Dahomey until 1975. Porto-Novo is the capital, but most of the government activity takes place in Cotonou. Cotonou is the largest city, main port, and commercial center of the country. See **Porto-Novo.**

Government. Benin is a republic. A president heads the government. The people elect the president to a five-year term. The president appoints a Cabinet of Ministers. The president and Cabinet carry out the operations of the government. An 83-member National Assembly is Benin's lawmaking body. The people elect Assembly members to five-year terms.

People. Benin's population consists of about 60 ethnic groups. The largest group, which consists of the closely related Fon and Adja, makes up about 60 percent of the population. They and the Yoruba, who make up about 10 percent, dwell in southern Benin. The Bariba, who also make up about 10 percent, are the most populous northern group. Most of Benin's people live in simple houses built by hand. However, some people, particularly in the cities, live in concrete homes.

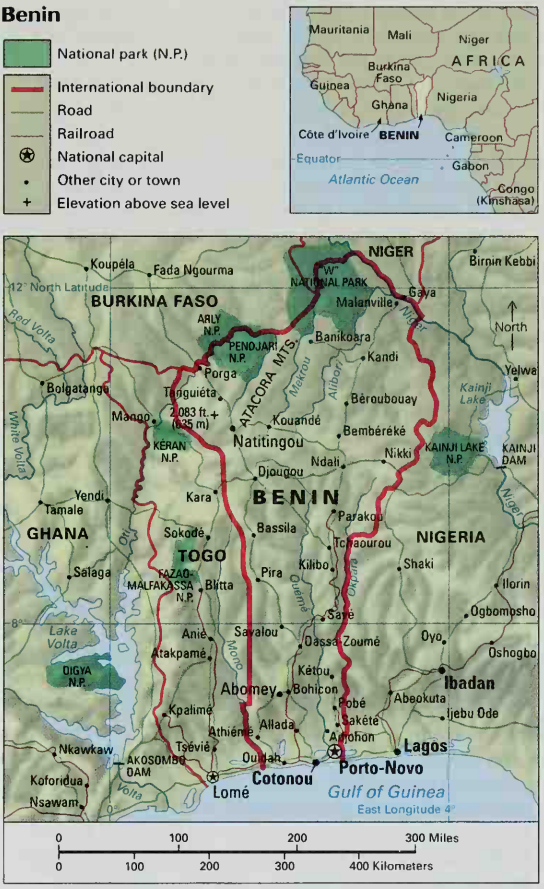
The women of Benin wear brightly colored dresses. A popular garment for men is the *agbade,* which includes trousers, short jacket, and full robe. Many people, particularly in southern Benin, wear clothing which is similar to that worn in the United States and Canada.

About 70 percent of Benin's people practice *animism,* the belief that all things in nature have spirits. Most of this group follow a form of animism called *voodoo.* About 17 percent of Benin's people are Christians, and 13 percent are Muslims. Most of the Christians live in southern Benin. The Muslims live in the north.

A law requires children ages 6 to 11 to attend school. But the law is not strictly enforced, and many children do not attend school. Most of Benin's adult population cannot read or write. For the country's literacy rate, see **Literacy** (table: Literacy rates).

Land and climate. The coast of Benin is flat and sandy, and has no natural harbors. Ships must anchor offshore, except at the artificially created port of Cotonou. Beyond the lagoons that lie behind the coastal strip, the country is flat and forested. About 50 miles (80 kilometers) inland is a great marsh. Benin's highest elevation, about 2,000 feet (610 meters), is in the Atacora Mountains in the northwest. The Ouémé River, the country's longest river, flows 280 miles (451 kilometers) into the Gulf of Guinea.

Southern Benin has a hot, humid climate. Rainy seasons occur in the south from April to July and from September to November. Northern Benin has less humidity and greater changes in daily temperatures. In the north, the rainy season lasts from April to October. Rainfall av-



WORLD BOOK maps

Facts in brief

Capital: Porto-Novo.
Official language: French.
Area: 43,484 mi² (112,622 km²). *Greatest distances*—north-south, 415 mi (668 km); east-west, 202 mi (325 km). *Coastline*—77 mi (124 km).
Elevation: *Highest*—Atacora Mountains, about 2,000 ft (610 m) above sea level. *Lowest*—sea level.
Population: *Estimated 2002 population*—6,422,000; density, 148 per mi² (57 per km²); distribution, 62 percent rural, 38 percent urban. *1992 census*—4,915,555.
Chief products: *Agriculture*—beans, cacao, cassava, coffee, corn, cotton, palm oil and kernels, peanuts, sorghum, yams.
National anthem: "L'Aube Nouvelle" ("The New Dawn").
Flag: A green vertical stripe is on the left side of the flag. A yellow stripe appears above a red one at the right. See **Flag** (picture: Flags of Africa).
Money: *Basic unit*—franc.

erages 20 inches (51 centimeters) a year in the southeast, 50 inches (130 centimeters) in the central section, and 35 inches (89 centimeters) in the north.

Economy. Benin is mainly an agricultural country. Its food crops include beans, corn, cassava, millet, rice, sorghum, and yams. The people raise cattle, goats, pigs, and sheep. Cotton is the country's leading export. Benin also exports products from its palm trees, such as palm oil and palm kernels. The oil from the kernels is used in soap and margarine. Other exports include cacao, coffee, peanuts, tobacco, and shea nuts, from which butter is made. Most of Benin's trade is with France.

The south has a few industrial plants, including palm oil refineries, industrial bakeries, and cotton mills. Benin produces some petroleum and limestone.

Benin provides an outlet to the sea for Niger by rail and road. It is a crossroads for coastal road traffic from Nigeria to Ghana. There are about 360 miles (580 kilometers) of railroad in Benin. The country has five airports.

History. During the 1100's or 1200's, several African kingdoms were founded in the region that is now Benin. By the 1600's, the kingdom of Dahomey, with Abomey its capital, controlled the area. Europeans began to establish slave-trading posts along the coast at about this time. The power of the king of Dahomey was based largely on the slave trade.

The palm oil trade replaced the slave trade during the 1800's. In 1851, France signed a trade agreement with the kingdom of Dahomey. Soldiers of the kingdom attacked French trading posts in 1892, but the French defeated them. France took over the area and made it part of French West Africa in 1904. Under the 1946 French constitution, the region became an overseas territory of France. The French gave it self-government in 1958. Benin, then called Dahomey, became a fully independent nation in August 1960. In 1975, the government changed the country's name from Dahomey to Benin.

Social unrest and political rivalries have led to frequent changes in Benin's government since the country's independence in 1960. Military leaders overthrew the government several times in the 1960's and 1970's. In May 1970, a civilian government was formed, headed by a three-man presidential council. In October 1972, a military government again took over the country. This government, headed by army leader Mathieu Kerekou, took control of Benin's most important businesses, formed its own political party, and banned all other parties.

Political and social unrest, led by government workers and students, marked the late 1980's. In early 1990, members of Benin's government and of opposing groups dissolved Kerekou's government and legalized all political parties. They formed a temporary government with Nicephore Soglo as prime minister. Kerekou remained as president, but Soglo became Benin's leader. The temporary government served until early 1991, when Soglo was elected president and a new legislature was chosen. Benin's new government ended nearly all governmental control of businesses. Kerekou was elected president in 1996, and again in 2001. Dennis D. Cordell

Benin, *beh NEEN,* was a West African kingdom that flourished from the early 1400's to the late 1800's. For most of that time, Benin was the most powerful state in the forest region of what is now Nigeria. At its peak, Benin controlled several states along the coast of the Gulf of Guinea, from Lagos in the west to Bonny in the east. The largest and most important ethnic group in the kingdom of Benin were the Edo.

Benin reached the height of its power in the late 1400's and 1500's. In 1486, the Portuguese arrived in Benin. Benin's rulers traded ivory, pepper, and slaves to the Portuguese in exchange for military supplies and cloth and other luxury goods. The port of Gwato served as a center for exporting slaves from West Africa.

Artists in Benin created many brass sculptures and ivory statues to honor Benin's kings and queens. Today, museums worldwide display these famous works. See **Africa** (The arts); **Sculpture** (African sculpture).

In 1897, the British conquered Benin. However, Benin's royal *dynasty* (family of rulers) still exists. According to traditional oral histories, the dynasty began around 1200 with King Oranmiyan, a noble of the Yoruba people and descendant of the founders of Ife (see **Ife**). The Royal Family of Benin plays an important social and ceremonial role among the Edo. Kevin C. MacDonald

Shostal

Bamboo huts perched on poles serve as homes for people of Benin who live in the small lagoon areas near the Gulf of Guinea. Some people, especially those in Benin's cities, live in homes made of concrete.

The Benin Kingdom about 1500

This map shows in yellow the area controlled by the Benin Kingdom. Benin became prosperous partly because it controlled the West African slave trade. The gray lines show the boundaries of present-day countries of West Africa.

WORLD BOOK map

Benjamin was the youngest and, next to Joseph, favorite son of Jacob. His name means *son of my right hand.* Joseph was Benjamin's older brother. The two were sons of Rachel, Jacob's second wife. The story of the great affection between these brothers is told in the last eight chapters of Genesis.

In Biblical history, Benjamin was the founder of the Israelite tribe called the Benjamites. It is recorded that this tribe had a place of honor next to the Tabernacle in the march through the wilderness. The Benjamites settled in a small territory north of Judah. The southern boundary of their land passed through Jerusalem. This is the meaning of the saying that the Lord "dwelleth between his [Benjamin's] shoulders" (Deuteronomy 33:12).

The Benjamites were famous warriors. Israel's first king, Saul, and many other heroes came from this tribe. The tribe was almost destroyed in a war against all the other tribes of Israel, but it recovered and joined with Judah at the division of the kingdom. Carole R. Fontaine

See also **Jacob; Joseph; Judah.**

Benjamin, Judah Philip (1811-1884), was a United States lawyer and statesman who was active in the Confederate cause during the American Civil War (1861-1865). He served successively as attorney general, secretary of war, and secretary of state in the Cabinet of Jefferson Davis, president of the Confederacy. Benjamin was perhaps the most trusted adviser of Davis.

Benjamin was born Aug. 6, 1811, at St. Croix, now one of the U.S. Virgin Islands. When he was a child, his parents moved to South Carolina. Benjamin attended Yale College and later became a leading lawyer and planter. He joined the Whig Party and was elected a U.S. senator from Louisiana in 1853. At the end of the war, Benjamin moved to London and resumed his law practice. His *Treatise on the Law of Sale of Personal Property* (1868) is still an important reference work. He died on May 6, 1884. Gabor S. Boritt

Bennett, Arnold (1867-1931), was an English novelist and playwright. His best stories are set in the "Five Towns" (actually six) of Stoke-On-Trent, in Staffordshire. His writings show the influence of the French Naturalists of the 1800's, who wrote about life with an intense realism and a sense of the power of environmental forces.

Bennett's best-known novel is *The Old Wives' Tale* (1908), a story of two sisters from Bursley, one of the Five Towns. His other Five Towns novels include *The Clayhanger Family,* a trilogy consisting of *Clayhanger* (1910), *Hilda Lessways* (1911), and *These Twain* (1915). Bennett collaborated with the English dramatist Edward Knoblock on *Milestones* (1912) and other plays. He dramatized his own comic novel *Buried Alive* (1908) as *The Great Adventure* (1913). The diaries published as *The Journals of Arnold Bennett* (1932-1933) are both a personal record and a minor chronicle of Bennett's age. Enoch Arnold Bennett was born on May 27, 1867, in Hanley, Staffordshire, in the district of the Five Towns. He died on March 17, 1931. Sharon Bassett

Bennett, Floyd (1890-1928), was an American pilot and mechanic. He piloted the airplane that he and American explorer Richard E. Byrd said they flew to the North Pole, on May 9, 1926. But some scholars doubt that Bennett and Byrd actually reached the pole. Bennett also flew with Byrd on the Donald MacMillan Greenland expedition in 1925. The plane Byrd used on his first trip to the South Pole, in 1929, was named for Bennett. Bennett was born on Oct. 25, 1890, near Warrensburg, New York. He died on April 25, 1928. Tom D. Crouch

See also **Byrd, Richard E.; MacMillan, Donald Baxter.**

Bennett, James Gordon (1795-1872), an American journalist, founded the *New York Herald* in 1835. Bennett revolutionized the newspaper business by hiring reporters to gather news. He also introduced foreign correspondence to journalism and used the newly invented telegraph. The *Herald,* sold at first for a penny an issue, was known for sensational crime stories and mockery of local figures. Bennett's fiery writing drew criticism, but the *Herald* attracted a large readership.

Bennett was born Sept. 1, 1795, in Banffshire (now Grampian Region), Scotland. He came to America in 1819 and worked as a teacher. But he was soon attracted to the newspaper business, and he worked as a writer and editor at a number of papers. In May 1835, Bennett began the *Herald* with $500. At his retirement in 1867, the newspaper had a circulation of more than 90,000 and annual profits of nearly $400,000. He died on June 1, 1872. Lee B. Jolliffe

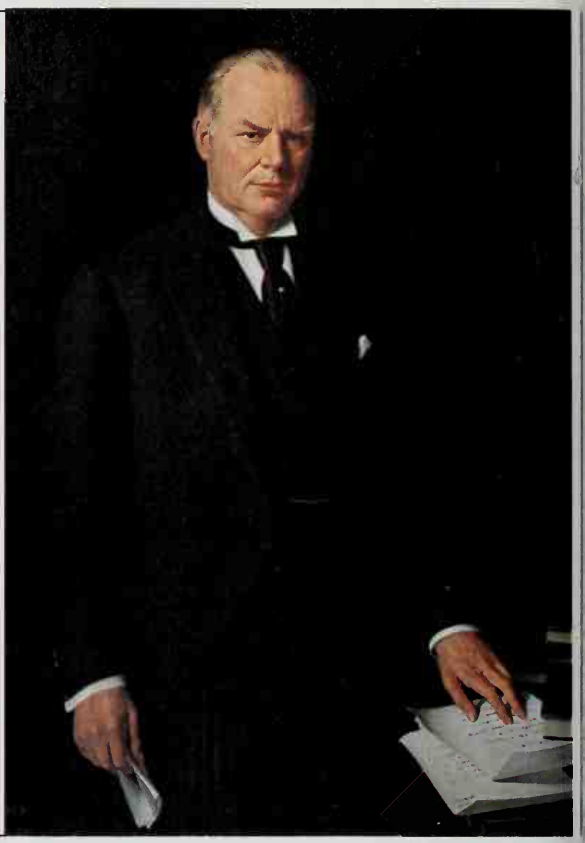
Bennett, James Gordon, Jr. (1841-1918), was an American journalist. The son of *New York Herald* founder James Gordon Bennett, he took over management of the newspaper in 1867, when his father retired. He became its owner in 1872, when his father died. As chief of the *Herald,* Bennett continued his father's traditions of sensationalism and aggressive newsgathering. In addition, he expanded the paper's coverage of foreign lands, sending his reporters on exotic expeditions around the world. He sponsored Henry M. Stanley's search in Africa for the missing British explorer David Livingstone (see **Stanley and Livingstone**).

Bennett was born on May 10, 1841, in New York City. He was educated primarily in Europe. Bennett helped John W. Mackay found the Commercial Cable Company in 1883 (see **Mackay, John William**). Bennett died on May 14, 1918. Lee B. Jolliffe

Richard Bedford Bennett

Prime Minister of Canada
1930-1935

King 1926-1930 | **Bennett** 1930-1935 | **King** 1935-1948



Detail of a portrait by Kenneth Forbes; Parliament Buildings, Ottawa (John Evans)

Bennett, Richard Bedford (1870-1947), Viscount Bennett of Mickleham, Calgary, and Hopewell, served as prime minister of Canada from 1930 to 1935. He held office during the early part of the Great Depression and had little success in strengthening the Canadian economy. However, his government established Canada's central bank and the nation's publicly owned broadcasting system.

Before Bennett became prime minister, he had achieved success as a corporation lawyer, businessman, and public official. He became a millionaire in his 40's by investing in real estate and by helping to carry out several business mergers. Bennett, a Conservative, first won election to the Canadian Parliament in 1911. He served as leader of the Conservative Party from 1927 to 1938. He moved to Great Britain in 1939 and became a member of the British House of Lords in 1941.

Bennett was a bachelor, and he lived in hotels most of his life. His fine clothes and erect bearing gave him the look of an aristocrat. He often wore dark-colored suits, high-collared shirts, and a derby. Bennett neither smoked nor drank, and he read the Bible daily.

Early life

Richard Bedford Bennett was born on July 3, 1870, near Hopewell Cape, N.B. He was the oldest of the five children of Henry John Bennett, a lumberman and shipbuilder, and Henrietta Stiles Bennett. Richard ranked high in his class at the local elementary and high schools. At the age of 18, he became a teacher in Douglastown, N.B.

In 1890, Bennett enrolled in Dalhousie University in Halifax to study law. He received his law degree in 1893 and soon became a partner in a law office in Chatham, N.B. Bennett had great confidence in his future. He predicted to friends that he would become prime minister of Canada and be a member of the British Parliament.

Early public career

Entry into politics. Bennett entered politics in 1896, when he won election to the town council of Chatham. In 1897, he received an offer to become a junior partner in the influential law firm of Canadian Senator James Lougheed. He eagerly joined the firm in Calgary, N.W. Ter.

In 1898, Bennett was elected to the Legislative Assembly of the Northwest Territories. In 1905, his district became part of the newly created province of Alberta. Bennett ran for election to the provincial legislative assembly that year but was defeated. He won election to the assembly in 1909.

Business activities. Bennett became a successful corporation lawyer while with the Lougheed law firm. His work for such clients as the Canadian Pacific Railway and the Hudson's Bay Company made him rich.

Bennett also was a business associate of William Max-

well Aitken, a boyhood friend from Chatham. They brought about mergers that resulted in the formation of the Alberta Pacific Grain Company, the Calgary Light and Power Company, and the Canada Cement Company. Real estate investments added to Bennett's growing fortune. By the early 1900's, he was a millionaire.

Federal offices. In 1911, Bennett won election to the Canadian House of Commons from Calgary East. He returned to his many business interests in 1917, rather than seek reelection. In 1921, Prime Minister Arthur Meighen appointed Bennett minister of justice and attorney general. Bennett tried to return to the House in the 1921 general election but was defeated along with most other Conservative candidates.

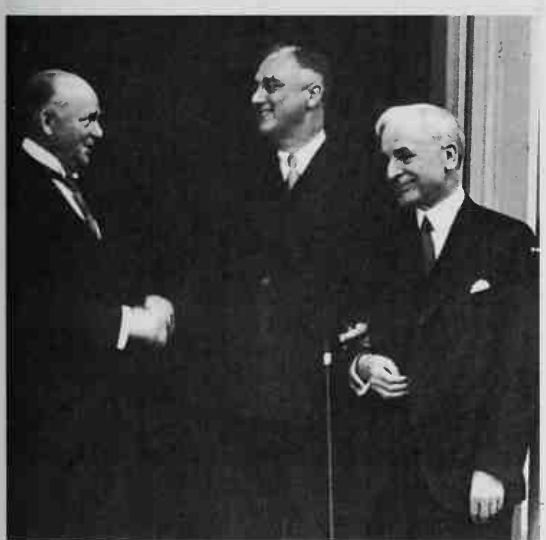
In 1925, Bennett was elected to the Canadian House of Commons from Calgary West. He served as minister of finance in the Meighen government that held office in 1926 from July to September.

Conservative Party leader. In 1927, Bennett succeeded Meighen as leader of the Conservative Party. Two years later, the Great Depression struck Canada, and thousands of workers lost their jobs.

Unemployment became the chief issue in the 1930 election. Most Canadians believed that Prime Minister W. L. Mackenzie King, the leader of the Liberal Party, had misjudged the signs of the coming Depression. They regarded Bennett as a symbol of personal success and hoped he could lead them to better times. During the campaign, Bennett promised to create new jobs and end unemployment by "blasting" Canadian exports into world markets. The Conservatives won an easy victory, and Bennett became prime minister of Canada on Aug. 7, 1930.

Prime minister

Early policies. During his first years as prime minister, Bennett personally headed the departments of foreign affairs and finance in his government. He attended the Imperial Conference of the British Commonwealth in London in 1930 and hosted the conference in Ottawa in 1932. In 1933, Bennett visited the United States for trade talks with President Franklin D. Roosevelt. That same year, he went to London for the World Monetary and Economic Conference and the World Wheat Conference. But none of these meetings stopped the decline of Canada's exports or provided help for the 650,000 jobless Canadians.



United Press Int.

Prime Minister Bennett, *left,* visited the United States in 1933 for economic conferences with President Franklin D. Roosevelt, *center.* With them is U.S. Secretary of State Cordell Hull.

In 1932, the government set up federal labor camps for single, unemployed men. The men, who helped build airports, received free housing and earned 20 cents a day. Also in 1932, legislation that was sponsored by Bennett established the Canadian Radio Broadcasting Commission, a national publicly owned broadcasting system.

Economic reforms. Bennett had believed that private industry would solve Canada's economic problems. But by the end of 1933, with the Depression becoming worse, he admitted the need to increase government control over the economy.

In 1934, H. H. Stevens, minister of trade and commerce under Bennett, publicly blamed large corporations for unfair labor and marketing practices. Bennett ordered a parliamentary investigation, and hearings supported some of Stevens's charges. Bennett then began to prepare legislation to correct the abuses.

Also in 1934, the Bennett administration established the Bank of Canada, which became the foundation of the nation's central banking system. Other legislation that year placed agricultural sales under federal supervision and helped farmers get credit to pay large debts.

In January 1935, Bennett announced a broad reform program that he called a "New Deal," the name of Roosevelt's economic program. Bennett's chief reforms established minimum wages and maximum hours of work. Another Bennett measure, the Prairie Farm Rehabilitation Act of 1935, aided the conservation of land and water in drought-stricken western Canada.

Bennett's reforms created a nationwide debate. Liberal Party leaders declared that, under Canada's constitution, only the provincial governments could adopt such measures. Alarmed Conservatives charged that the reforms would destroy private industry. Many Canadians approved the reforms but felt they had come too late. Still others, including Stevens, argued that the reforms were too weak.

Several thousand men from the relief camps in British Columbia also challenged the Bennett government in 1935. The men staged a march on Ottawa, the Canadian capital, to protest conditions in the camps. Bennett met the leaders of the demonstration and urged them to end the march. They did so in July, but only after a riot in Regina, Saskatchewan, resulted in the death of a police officer.

The 1935 election. Seeking a vote of confidence, Bennett called for a general election to be held in October 1935. But the Depression, conflict among the Conservatives, and the rise of new political parties in western Canada made a Conservative defeat inevitable.

In the election, the Liberal Party won the largest parliamentary majority in Canadian history. Mackenzie King replaced Bennett as prime minister on Oct. 23, 1935. Bennett, who had been reelected to Parliament from

Calgary West, became leader of the Opposition in the House of Commons.

Later years

In 1938, Bennett resigned as a Member of Parliament and as Conservative Party leader. He moved to England the next year and bought a mansion in Surrey. In 1941, Bennett received the title of viscount and became a member of the British House of Lords.

During World War II (1939-1945), Bennett donated large amounts of money to the British war effort. His health grew steadily worse during the mid-1940's, and he died in his home on June 26, 1947. Richard Wilbur

See also **Prime minister of Canada.**

Additional resources

Glassford, Larry A. *Reaction and Reform: The Politics of the Conservative Party Under R. B. Bennett, 1927-1938.* Univ. of Toronto Pr., 1992.

Waite, P. B. *The Loner: Three Sketches of the Personal Life and Ideas of R. B. Bennett, 1870-1947.* Univ. of Toronto Pr., 1992.

Benny, Jack (1894-1974), was an American radio and television comedian. He entered show business at the age of 17, playing his violin in a vaudeville act. He made his first motion picture in 1929, and later appeared in more than 20 films. After 18 years on radio, he first appeared on television in 1950. His television show used his old radio theme of the comedy adventures of a vain, stingy man. Benny was born in Chicago. His real name was Benjamin Kubelsky. Gerald Bordman

Bentgrass is the name of many related kinds of grasses that have rough stems, small flowers, and seeds that grow in delicate clusters. Bentgrasses are native to Europe and Asia and were introduced to the United States by early colonists.

Two kinds, *creeping bentgrass* and *colonial bentgrass,* are widely used for golf courses and lawns. Both are grown from seeds. Creeping bentgrass also may be grown by planting tufts of the grass. Both kinds spread by means of creeping stems that take root at intervals, eventually forming a thick, soft turf. They can withstand close mowing and grow best in the cooler parts of the United States, especially the Pacific Northwest, the Northeast, and the north-central region.

Another kind of bentgrass, called *redtop,* is native to Europe but now grows widely in the United States. It is used for pastures and lawns and for erosion control.

Douglas A. Johnson

Scientific classification. Bentgrasses belong to the grass family, Poaceae or Gramineae. The scientific name for creeping bentgrass is *Agrostis stolonifera.* Colonial bentgrass is *A. capillaris* and redtop is *A. gigantea.*

Bentham, Jeremy (1748-1832), an English philosopher, founded the philosophy known as Utilitarianism. He thought that ideas, institutions, and actions should be judged on the basis of their *utility* (usefulness).

Bentham defined utility as the ability to produce happiness. He advocated the production of the greatest possible amount of happiness in and for society. Bentham thought of happiness and good in terms of pleasure. He believed that (1) pleasure can be exactly measured, (2) individuals care only about increasing their own pleasure and decreasing their pain, and (3) a person should always do what will produce the greatest good for the greatest number of people. Bentham set up a number of principles for measuring pleasure. He also sought an opportunity to organize a country's laws and institutions in such a way that they would place the general good above each person's individual pleasure.

His criticisms brought about many needed reforms. For example, the British law courts were reformed because they had not promoted the good of all.

Bentham's writings include *Fragment on Government* (1776) and *Introduction to the Principles of Morals and Legislation* (1789). He was born in London. Bentham graduated from Queen's College, Oxford, in 1763.

Stephen A. Erickson

See also **Ethics.**

Benton, Thomas Hart (1782-1858), served as United States senator from Missouri for 30 years. He became a senator when Missouri entered the Union in 1821. Benton brought Western support to President Andrew Jackson and the new Democratic Party. He led the antibank Senate forces during Jackson's fight against the second United States Bank (see **Jackson, Andrew** [The Bank of the United States]). Benton's fight for gold and silver currency won him the nickname "Old Bullion." He also favored selling government lands cheaply to Western farmers. Benton opposed the extension of slavery into U.S. territories. He was born in Hillsboro (now Hillsborough), North Carolina. He was a great uncle of Thomas Hart Benton, a famous painter. William E. Foley

Benton, Thomas Hart (1889-1975), was an American painter. With artists John Steuart Curry and Grant Wood, he developed and promoted a style of American art called Regionalism. The style emerged in the 1920's and continued through the early 1940's.

Benton urged American artists to paint in a style free of foreign influences. He wanted American art to be democratic, portraying scenes from the daily life of ordinary people in a direct and easily understood style. Benton took most of his subjects from the Midwest, where he lived. He painted both the difficulties and pleasures of being a farmer, railroad worker, miner, saloonkeeper, or politician. He also created scenes of family life. Benton became nationally known and also painted works in and about Hollywood and New York City.

Benton's distinctive style emphasizes sculptural, somewhat elongated and stylized forms with strong contours and colors. He combined these elements into powerful, rhythmic compositions that he believed expressed the vitality of American life. Several of Benton's series of paintings and murals deal with American history and folklore. His *America Today* (1930-1931) in New York City helped revive mural painting in the nation.

Benton was born in Neosho, Missouri. As a young man, he experimented with modern art styles in Paris. By the mid-1920's, after returning to the United States, he had rejected modern painting as being too theoretical and unrelated to American life. Deborah Leveton

See also **Western frontier life in America** (picture: Jesse James).

Bentsen, Lloyd Millard, Jr. (1921-), was United States secretary of the treasury from 1993 to 1994 under President Bill Clinton. Before he was appointed to the post, Bentsen had represented Texas in the U.S. Senate since 1971. In addition, Bentsen was the Democratic nominee for vice president of the United States in 1988. He and his presidential running mate, Governor Michael

S. Dukakis of Massachusetts, were defeated by their Republican opponents, Vice President George H. W. Bush and Senator Dan Quayle of Indiana.

Bentsen was born on Feb. 11, 1921, in Mission, Texas. He received a law degree from the University of Texas at Austin in 1942. From 1942 to 1945, during World War II, Bentsen served in the Army Air Forces in Europe. He was shot down twice and received the Distinguished Flying Cross for heroism. In 1943, Bentsen married Beryl Ann Longino. They had three children.

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Lloyd M. Bentsen, Jr.

Bentsen was elected to the U.S. House of Representatives in 1948. He was reelected in 1950 and 1952. Bentsen chose not to run for a fourth term. In 1955, with his family's financial assistance, Bentsen became president and chief executive officer of an insurance company in Houston. Bentsen expanded the business into a profitable holding company and became a millionaire.

Bentsen returned to politics in 1970. That year, he was elected to the U.S. Senate, defeating Republican George H. W. Bush. Bentsen helped write the Employee Retirement Income Security Act of 1974. This law set minimum federal standards for the financing and operation of private pension plans. In 1987, Bentsen became chairman of the Senate Finance Committee. Guy Halverson

Benz, *behnts,* **Karl** (1844-1929), a German engineer, pioneered in building motor-driven vehicles. He founded Benz & Company in Mannheim, Germany, to manufacture gasoline engines. He started to build his first gasoline engine in 1878 and produced his first motor vehicle in 1885. This three-wheeled car had an electric ignition, a water-cooled engine, and a differential gear, all of which are still common in automobiles today. He also designed a float-type carburetor and a transmission system. Benz was born on Nov. 25, 1844, in Karlsruhe. See also **Automobile** (picture: The Benz carriage).

William L. Bailey

Benzedrine. See Amphetamine.

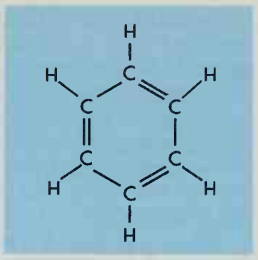
Benzene, *BEHN zeen,* is a colorless liquid with a pleasant odor. It is used in industry in the production of polystyrene, synthetic rubber, nylon, detergents, and dyes. Benzene's vapor is poisonous if breathed too long.

Most benzene is obtained from petroleum. The benzene molecule has its atoms arranged in a ring called the *benzene ring.* This benzene ring arrangement is also found in aniline, a chemical from which many dyes are made; in benzaldehyde, an oil made from bitter almonds; and in TNT, aspirin, oil of wintergreen, and some amino acids. Benzene is sometimes called *benzol.*

Benzene is lighter than water and is almost insoluble in it. Benzene vapor burns easily and has a smoky flame because of the carbon it contains.

Benzene was discovered by the British physicist Michael Faraday in 1825. In 1865, August Kekulé, a German chemist, proposed the structure of the benzene molecule that scientists accept today. Kekulé's proposal was a major step in the development of organic chemistry. It led to hundreds of molecular combinations. Each combination produces a substance with different characteristics.

The chemical formula for benzene is C_6H_6. Benzene melts at 5.5 °C (42 °F) and boils at 80.1 °C (176.2 °F). It is the simplest of a group of compounds called *aromatic hydrocarbons.* Donald L. Stinson



Benzene ring diagram

See also **Aniline; Faraday, Michael.**

Benzocaine, *BEHN zoh kayn,* is a drug that reduces pain or itching in minor wounds, sores, and burns on skin and mucous membranes. It is a *local anesthetic*—that is, a drug that works in or on a specific area of the body. Unlike some local anesthetics, benzocaine is not injected. Benzocaine is applied directly to the area, where it interferes with pain signals sent by nerve fibers to the brain.

Benzocaine is absorbed slowly, and therefore its anesthetic action lasts a long time. Its slow absorption also prevents the build-up of toxic levels in the body. Many nonprescription medicines contain benzocaine. For example, it is found in ointments and sprays for treating sunburn, insect bites, and minor skin injuries, and in suppositories for relieving hemorrhoids.

Benzocaine is a white, odorless powder that was developed in Germany in 1890. It was given the trade name *Anesthesin* because of its anesthetic properties. The discovery of benzocaine led to the development of *procaine,* a local anesthetic that became a substitute for cocaine anesthesia. Unlike cocaine, neither procaine nor benzocaine is addictive. Edwin S. Munson

See also **Anesthesia** (Local anesthesia); **Procaine.**

Benzodiazepine, *BEHN zoh dy AZ uh peen,* is any of a group of drugs widely prescribed to relieve anxiety. Benzodiazepines also are used to treat insomnia, relieve muscle spasms, and prevent the seizures associated with epilepsy and certain other conditions.

Physicians use benzodiazepines to treat severe anxiety and disorders that involve anxiety, such as panic disorder and phobias. The drugs are generally prescribed for short-term use—that is, one to six months. However, some persistent conditions may require the patient to take benzodiazepines for six months or longer.

Benzodiazepines are also useful in the treatment of alcoholism. When undergoing treatment for alcoholism, patients first go through a period of *withdrawal,* during which all alcoholic beverages are withheld. During this time, physicians give patients benzodiazepines to help prevent them from developing the complications that can result from the abrupt discontinuation of alcohol use. These complications include high blood pressure, rapid heart rate, and *delirium tremens* (the DT's), a condition that causes agitation, mental confusion, hallucinations, and sometimes death. See **Alcoholism.**

Benzodiazepines can cause sleepiness and can interfere with a person's memory and coordination. They can also cause dependency, especially in individuals who have a history of drug addiction and in people who use the drugs for six months or longer.

Before benzodiazepines were introduced in 1960, doctors treated anxiety with barbiturates and other sedatives. However, these drugs are not as safe as benzodiazepines, and they are more likely to be misused and cause serious addiction. Commonly used benzodiazepines include alprazolam (trade name, Xanax), chlordiazepoxide (Librium and others), diazepam (Valium and others), lorazepam (Ativan and others), and triazolam (Halcion). Alan M. Gruenberg

See also **Anxiety; Barbiturate; Tranquilizer.**

Beograd. See **Belgrade.**

Beothuk Indians, *bee AH thuhk,* were a people who lived on the island of Newfoundland off the eastern shore of Canada. They were probably the first North Americans encountered by the early European settlers. The Europeans called the Beothuk "red Indians" because they painted their bodies, clothing, tools, and weapons with a red pigment.

The Beothuk lived in bands of closely related families. The group probably consisted of 6 to 10 bands. Each band had fewer than 100 people. Despite the small total population, traces of the Beothuk's existence have been found on the coast of every major Newfoundland bay.

The Beothuk lived in cone-shaped houses made of bark. Unlike many other Indians, they did not raise crops. They fished and hunted on the coast from late winter through early fall. When the first snow fell, they moved inland to hunt caribou. They made bark containers and used stone to make arrowheads. Scholars do not know what language the Beothuk spoke, but it probably belonged to the Algonquian languages.

During the 1700's, French settlers accused the Beothuk of petty thievery and began to kill them. The Micmac Indians, who came to Newfoundland from Nova Scotia, joined the French attacks against the Beothuk. The surviving Beothuk fled inland, but they could not live the year around without food from the coastal area. They became extinct in 1829. James A. Tuck

Beowulf, *BAY uh wulf,* is an epic poem that is considered the first great work of English literature. *Beowulf* has survived in only one manuscript, and its author is unknown. It is written in Old English, the language the Anglo-Saxons used in England from about A.D. 500 to 1100. Most scholars date the poem from the 700's, but some date it much closer to the end of the Old English period. Like all Old English poetry, *Beowulf* uses *accent* (the emphasis with which a syllable is pronounced) and *alliteration* (words that begin with the same sound).

The poem describes the adventures of Beowulf, a mighty warrior who has the qualities most admired by the Anglo-Saxons—strength, courage, loyalty, and generosity. Beowulf goes to the aid of the Danish king, whose royal hall has been repeatedly raided by a savage monster named Grendel. Beowulf kills Grendel and later slays the monster's fearsome mother. In his final battle, Beowulf kills a fire-breathing dragon, but he himself is fatally wounded. The poem ends with a description of Beowulf's funeral. Paul Strohm

See also **English literature** (Old English literature; picture).

Berbers are a people of northwest Africa and the Sahara. There are about 15 million Berbers, and they speak a variety of Berber dialects. Many follow Arabic customs and traditions. Almost all Berbers are Muslims.

Most Berbers depend on herding and farming for a living. They live in compact villages, often in rugged, mountain areas. The Kabyle of Algeria and the Berber tribes of the Atlas and Rif mountains in Morocco follow these life styles. Some Berber-speaking groups, such as the Tuareg of the Sahara, roam the desert with herds of camels, cows, goats, and sheep.

Berbers were the earliest known inhabitants of the western Mediterranean coast of Africa. They probably lived in this region about 3000 B.C. or earlier. Since about 600 B.C., the Carthaginians, Romans, Vandals, Byzantines, Arabs, Turks, Spaniards, French, and Italians have ruled portions of the Berber homeland at various times. Of these invaders, the Arabs had the greatest influence on the Berber culture.

During the periods of Carthaginian and Roman rule—from about 600 B.C. to the A.D. 400's—Berber traders linked the Mediterranean coast to the gold, ivory, and slave markets of West Africa. Some coastal Berbers became Roman citizens. But Berbers in the mountains and desert continued to live in independent groups.

Arab invasions of North Africa began in the 600's. Under Arab influence, many Berbers became Muslims. During the 700's, Muslim Berbers joined with Arabs in conquering Spain.

After 1050, empires ruled by Berbers controlled much of North Africa for nearly 200 years. Desert Berbers organized the Almoravid empire, which began about 1050. At its height, this empire ruled the regions that are now Morocco, western Algeria, and southern Spain. About 1150, mountain Berbers overthrew the Almoravids and established the Almohad empire. The Almohads controlled all of what are now Algeria, Morocco, and Tunisia, and part of Spain. This large empire split apart during the first half of the 1200's. But Berbers kept control of some lands from the former empires until the 1500's.

Meanwhile, Arabs continued to move into North Africa. In time, they occupied most of the coastal region, and the Berbers there became absorbed into Arab society. Berber languages, traditions, and customs remain only in the mountains and deserts, which were relatively isolated from the Arabs. Kenneth J. Perkins

See also **Africa** (pictures); **Hamites; Tuareg.**

Berdyaev, *buhrd YAH yehf,* **Nicolas** (1874-1948), was a Russian religious and political thinker. He was a zealous member of the Russian Orthodox Church and wanted to reorganize society according to Christian principles. He is considered a Christian existentialist (see **Existentialism**).

Berdyaev thought it was important to distinguish between the material world governed by the necessity of natural laws, and the spiritual world of freedom. He believed that each person belongs to both worlds—to the material world as an animal and to the world of freedom as a spirit. Berdyaev did not place the greatest importance upon knowledge, which merely mirrors the material world, but upon the creative act, which bridges the gap between the two worlds. He wrote *Freedom and the Spirit* (1935), *The Destiny of Man* (1937), and *Dream and Reality: An Essay in Autobiography* (1950).

Berdyaev was born in Kiev. He was expelled from Russia in 1922, and settled in Paris in 1924. Ivan Soll

Berg, Alban, *ahl BAHN* (1885-1935), was an Austrian composer. At the age of 19, he became a stu-

dent of composer Arnold Schoenberg and remained close to him for the rest of his life. He generally followed his teacher in the use of *atonality* and the *12-tone* system (see Music [Tone]). One of Berg's earliest works to use atonality was his String Quartet of 1910. His first major work using the 12-tone system, also for string quartet, was the *Lyric Suite* (1927). Berg's later 12-tone works included his Violin Concerto (1936) and his second opera, *Lulu,* first performed in its entirety in 1979.

Despite labels such as *atonal* and *12-tone,* Berg's style remained flexible. Berg's works are rich in symbolism. He often chose pitches whose letters spelled out or suggested certain names or initials. Berg was also obsessed with numbers. In the *Lyric Suite,* the metronome markings and measure totals for each movement are multiples of 23 or 10, numbers he assigned to himself and to the woman to whom he secretly dedicated the work.

Berg was born in Vienna. He was composing songs by the age of 15 and gained fame in 1925 with the premiere of his first opera, *Wozzeck.* Stewart L. Ross

See also Opera (*Wozzeck*); Schoenberg, Arnold.

Bergamot, *BUR guh maht,* is a name given to several plants. The *bergamot orange,* also called *bergamot tree,* is a citrus tree grown commercially in southern Italy. It is grown as an ornamental plant in the Southern United States, in California, and in France. The tree produces small, fragrant flowers and a round or pear-shaped yellow fruit. The rind of the fruit is used to make a liquid called *oil of bergamot.* The oil has a strong, pleasant odor and is used in making perfume.

Various North American herbs are also known as *bergamots.* Common species include the *wild bergamot,* the *purple bergamot,* and the *prairie bergamot.*

Wilfred F. Wardowski

John Shaw, Bruce Coleman Ltd.

Purple bergamots

Scientific classification. The bergamot orange belongs to the rue family, Rutaceae. It is *Citrus aurantium.* The herb bergamots belong to the genus *Monarda* in the mint family, Labiatae.

Bergen (pop. 211,866) is the second largest city in Norway. Only Oslo has more people. Bergen lies at the head of By Fiord and is the chief seaport of western Norway. For the location of Bergen, see Norway (map).

Bergen has a mild climate and an average annual precipitation of 80 inches (200 centimeters). For Bergen's monthly weather, see Norway (Climate). The city carries on a large trade in dried fish, herring, and machinery. Bergen was founded in A.D. 1070. It became a trading center of the Hanseatic League during the Middle Ages (see Hanseatic League). The city has many wooden houses that are hundreds of years old. The University of Bergen was founded in 1948. M. Donald Hancock

Bergen-Belsen was a concentration camp near Hanover in north-central Germany, during World War II. The Nazis built the facility in 1943 as a detention camp for Jews. In the winter of 1944-1945, the camp's population soared. At that time, German forces were in retreat from Allied forces. The Nazis evacuated concentration camps outside Germany and moved many of the prisoners to Bergen-Belsen, which became dangerously overcrowded. From January to mid-April 1945, almost 50,000 people died there of starvation, disease, or exhaustion, or were murdered by the guards. British troops liberated the camp on April 15, 1945. The soldiers found about 60,000 starving prisoners and more than 10,000 unburied corpses. Charles W. Sydnor, Jr.

Berger, Victor L. (1860-1929), became the first Socialist to be elected to the United States Congress. He served from 1911 to 1913 as a Wisconsin representative. He was reelected in 1918, and again in 1919. The House of Representatives refused to admit Berger in 1919 because of his pacifist opposition to World War I (1914-1918). He was sentenced to 20 years in prison on a charge of giving aid and comfort to the enemy in wartime. The U.S. Supreme Court reversed the sentence in 1921. Berger was again elected to Congress and served from 1923 to 1929. He was born in Rehbach, Austria, and moved to Milwaukee in 1880. Nick Salvatore

Bergerac, Cyrano de. See Cyrano de Bergerac, Savinien de.

Bergman, Ingmar (1918-), is a Swedish motion-picture director. Bergman became famous for his complex studies of guilt, morality, and religious faith. Most of his films are highly symbolic, and some filmgoers have found them hard to understand. But critics have praised his imaginative use of black-and-white photography and his ability to gain outstanding performances from actors. Bergman writes his own original screenplays. His most acclaimed films include *Smiles of a Summer Night* (1955), *The Seventh Seal* (1956), *Wild Strawberries* (1957), *The Magician* (1958), *Winter Light* (1962), and *Cries and Whispers* (1972).

Ernst Ingmar Bergman was born in Uppsala. He gained recognition in 1944 as a scriptwriter for the film *Torment.* Bergman's *The Virgin Spring* (1960), *Through a Glass Darkly* (1961), and *Fanny and Alexander* (1983) won Academy Awards as best foreign film of the year. Several of his films deal with the lack of communication among his tormented characters. The series *Persona* (1967), *Hour of the Wolf* (1968), and *Shame* (1968) concerns characters questioning the significance of their lives. As a stage director, Bergman headed the Royal Dramatic Theatre in Stockholm from 1963 to 1966. He wrote two volumes of autobiography, *The Magic Lantern* (1988) and *Images* (1993). Gene D. Phillips

Bergman, Ingrid (1915-1982), was a motion-picture actress best known for her beauty and her convincing portrayals of innocent women of integrity. She played such roles in *Casablanca* (1942), *For Whom the Bell Tolls* (1943), and *Joan of Arc* (1948).

Bergman won Academy Awards as best actress for her performances in *Gaslight* (1944) and *Anastasia* (1956). She also won an Academy Award as best supporting actress in *Murder on the Orient Express* (1974).

United Press Int.

Ingrid Bergman

Bergman was born in Stockholm, Sweden. She began her acting career in Sweden in 1935. Bergman made her first American film, *Intermezzo,* in 1939. Her other U.S. motion pictures include *Spellbound* (1945), *Notorious* (1946), *Indiscreet* (1958), and *Autumn Sonata* (1978). Bergman spoke Italian and French as well as Swedish and English and made films in all these languages. She also acted on the stage in many European cities. *Ingrid Bergman: My Story* (1980) is her autobiography.

Louis Giannetti

Bergson, *BURG suhn* or *behrg SAWN,* **Henri,** *ahn REE* (1859-1941), was a French philosopher. His books *Time and Free Will* (1889), *Matter and Memory* (1896), and *Creative Evolution* (1907) present the principles of his philosophy. Bergson believed that time is the great reality. But by "time" he did not mean what is usually understood. According to Bergson, time does not exist in the ordinary sense of yesterday, today, and tomorrow. He believed in a concept of time that he called *duration.* Bergson viewed duration as a constant flow from the past into the future, not just as a succession of instants.

Bergson believed that time in this sense holds the possibility for new experiences. "Each moment," he stated, "is not only something new, but something unforeseeable." He believed that creative evolution is possible because reality is a past that constantly becomes something new and is also a present constantly emerging into the future. He held that intuition was the most trustworthy guide to understanding. Unlike the intellect, it did not falsify things by analyzing them.

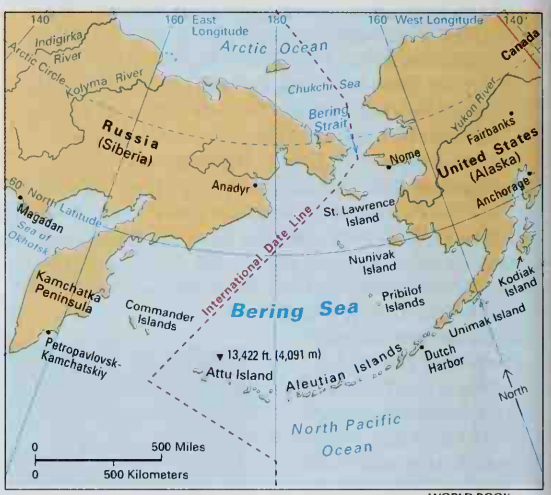
Bergson was born in Paris. He was a professor at the Collège de France from 1900 to 1921, and became famous as a teacher, lecturer, and author. He received the 1927 Nobel Prize for literature. Stephen A. Erickson

Beriberi, *BEHR ee BEHR ee,* is a disease caused by a lack of vitamin B_1, or thiamine. The name is taken from the Sinhalese, and means *I cannot,* because the victim is too sick to do anything. Beriberi is characterized by stiffness of the lower limbs, paralysis, and pain. Muscle tissue gradually breaks down, and anemia develops. In advanced cases, the nervous system is affected.

Beriberi was once common in China, Japan, the Malay Peninsula, and the Philippines. The diet in these countries consisted largely of white rice that had lost its thiamine content during milling. Changes in the diet, higher standards of living, and the availability of synthetic thiamine have greatly reduced the occurrence of beriberi in these countries. Beriberi may also occur in people who drink much alcohol over a long period of time. In these cases, alcohol is substituted for important foods. This causes vitamin deficiencies, particularly of vitamin B_1. Beriberi is treated by thiamine injections and a diet rich in thiamine. Quinton R. Rogers

Bering, *BAIR ihng* or *BEER ihng,* **Vitus,** *VEE tus* (1680-1741), was a Danish navigator in the Russian Navy who led the first European expedition to explore a major part of Alaska's coast. In 1728, Bering's first attempt to sight Alaska failed when fog blocked his view from the channel later named the Bering Strait. From 1733 to 1741, Bering commanded a Russian project in which hundreds of people explored and mapped the Siberian coast of the Arctic Ocean. As part of this project, Bering made another attempt to explore Alaska. In 1741, he saw southeastern Alaska's Mount St. Elias from his ship. He did not land, but he sailed along the Alaskan coast and charted much of it. On his return voyage, heavy fog forced him to land on present-day Bering Island, where he died of scurvy. The Bering Sea, the Bering Strait, and Bering Island were named after him. Bering was born in Horsens, Denmark. William Barr

Bering Sea, *BAIR ihng* or *BEER ihng,* is the northern part of the Pacific Ocean between the region of Siberia in Russia and the state of Alaska in the United States. The Aleutian Islands and the Commander Islands mark the sea's southern border. The Bering Strait connects the Bering Sea and the Chukchi Sea in the north. In 1822, Captain V. M. Golovnin of the Russian Navy named the sea for the Danish explorer Vitus Bering.



WORLD BOOK map

The Bering Sea is part of the North Pacific Ocean. The International Date Line runs across the sea.

At Bering Strait, the United States and Russia are only about 50 miles (80 kilometers) apart. The Bering Sea is about 1,200 miles (1,930 kilometers) wide and 950 miles (1,530 kilometers) long. Its greatest depth is 13,422 feet (4,091 meters). Claus-M. Naske

See also Alaska (European Exploration); **Bering, Vitus.**

Bering Sea controversy, *BAIR ihng* or *BEER ihng,* was a dispute between the United States and Britain in the late 1800's. It arose when the United States claimed control over the Bering Sea to protect fur seals.

The most valuable seal herds in the world lived around the Pribilof Islands in the Bering Sea. The United States had acquired these islands from Russia in 1867. In 1870, the United States tried to protect the seals by limiting the number that could be killed annually and by leasing sealing-rights to one company. But U.S. authority extended only over the waters within 3 nautical miles (5.5 kilometers) of the islands. Canadians, Mexicans, Russians, Japanese, and Americans sailed close to the islands and killed the female seals when they came out into the ocean. As a result, the United States claimed authority over all Bering Sea waters. Britain protested. The matter was turned over to an international tribunal. In 1893, the board decided that the United States could not control these waters. But it placed certain limitations on killing seals there.

In 1911, the United States, Russia, the United Kingdom, and Japan signed an agreement to protect the seal herds. It allowed the United States a monopoly of the catch. Japan withdrew from the agreement in 1941. In 1957, the United States, Japan, the Soviet Union, and Canada signed an agreement to protect fur seals in the northern Pacific. The treaty expired in 1984. Since then, animal protection laws have prevented commercial hunting of fur seals in the Bering Sea. Kinley J. Brauer

See also **Pribilof Islands; Seal** (Hunting of seals).

Bering Strait. See **Bering Sea** (with map).

Berio, *BAIR ee oh,* **Luciano,** *loo chee AHN oh* (1925-), an Italian composer, became a leader of experimental music in Europe. Berio's works and his experiments with electronic instruments and devices have influenced young composers in Europe and the United States. Berio is also a teacher and conductor.

Berio has composed several works for voice and instruments. Some of his compositions call for unusual vocal techniques, such as whispering, moaning, laughing, humming, and howling. One way Berio focuses on words is by using tape-recorded speech in his compositions. In *Thema (Omaggio a Joyce)* (1958), Berio recorded fragments of James Joyce's novel *Ulysses* in three languages. He then cut and electronically rearranged the readings to highlight the meaning and the sound of syllables, words, and sentences.

Berio uses the *collage* technique, which employs individual elements at the same time or one after another. For example, in *Sinfonia* (1968), for voices and orchestra, he incorporates political slogans, poetry, quotations from philosophical writings, and passages from other composers' music within his own music. Berio's other works include *Passaggio* (1963), *Laborintus II* (1965), and *Recital I* (1972). These pieces involve theatrical speech, gestures, and lighting effects, or require performers to move around on the stage. Berio was born near Imperia. Stephen Jaffe

Berkeley, *BURK lee,* California (pop. 102,743), lies on a range of low hills on the eastern shore of San Francisco Bay. It is just north of Oakland and the San Francisco-Oakland Bay Bridge (see **California** [political map]).

Several schools of theology and the main campus of the University of California are in the city. Berkeley is known for its fine bookstores and restaurants. Industries in the city include biotechnology, book and software publishing, and the manufacture of food products.

Ohlone, or Costanoan, Indians were the first inhabitants of what is now Berkeley. In 1820, Luis Maria Peralta, a Spanish soldier, received a land grant that included the east bay region. Developers settled a portion of this land in 1853 as Ocean View. In 1866, the town was named for George Berkeley, an Anglican bishop and philosopher. It was incorporated as a city in 1878. It has a council-manager form of government. Betty Marvin

See also **California, University of.**

Berkeley, *BURK lee* or *BAHRK lee,* **George** (1685-1753), was an Anglican bishop and philosopher. He tried to reconcile the science of his day with Christianity.

Berkeley argued that physical things, such as tables and trees, consist entirely of the ideas or sensations we have of them. In his view, an apple is nothing but its color, shape, texture, weight, taste, and other qualities, all of which we experience through our senses. He argued that the qualities or ideas that we experience exist only in our minds. They change as the person perceiving them changes. For example, the same lukewarm water seems warm to a cold hand and cool to a warm hand. Thus, it seemed to Berkeley, the qualities we perceive are really ideas that depend upon the mind perceiving them and have no independent existence.

Other philosophers had believed that a physical thing also consists of matter. Matter is the stuff in which the various qualities are supposed to exist. Matter supposedly exists outside of and independent of the mind. But because we never have any direct experience of matter, Berkeley claimed that we have no good reason to think it exists.

If, as Berkeley argued, the entire physical world consists only of ideas, then the world exists only in the minds that perceive it. However, because we believe that physical things continue to exist when we are not observing them, we must assume that there exists a mind that observes all physical things all the time. It is only the constant observation by such a mind that keeps things in existence when we are not observing them. This universally present and observant mind is God.

Because Berkeley believed that things are entirely composed of ideas, he is a representative of philosophical *idealism.* Because his view of the world is restricted to what we learn in our direct experience of it, he also represents philosophical *empiricism.* Berkeley was born in County Kilkenny, Ireland. Ivan Soll

See also **Idealism; Philosophy** (Empiricism).

Berkeley, *BURK lee* or *BAHRK lee,* **Sir William** (1606-1677), became governor of colonial Virginia in 1642. Virginians had lived near the Atlantic Coast since the beginning of the colony. Berkeley helped open up the inland territory. He sent out explorers who crossed the Blue Ridge Mountains, and he led a force that put down an Indian attack in 1644. Berkeley also used his family's powerful influence in England to defend the business interests of Virginia's tobacco growers.

Berkeley was forced to resign in 1652 after the Puritan leader Oliver Cromwell had gained control of England's government. When King Charles II came to the throne in 1660, Berkeley again became governor of Virginia. He refused to send troops against attacking Indians in 1675. This refusal sparked Bacon's Rebellion (see **Bacon's Rebellion**). He was called back to England in 1677. Berkeley was born near London. T. H. Breen

Berkelium, *BUR klee uhm* or *bur KEE lee uhm,* is an artificially created radioactive element. Its chemical symbol is Bk, and its atomic number is 97. Ten isotopes of the element are known. The most stable isotope has an atomic weight of 247 and a half-life of 1,400 years. Berkelium-249, which has a half-life of 314 days, can be produced in small amounts in a nuclear reactor. This isotope has been used to study many chemical compounds of berkelium.

A team of scientists first prepared and identified berkelium in 1949. They worked at the University of California at Berkeley, after which they named the element. They obtained berkelium by bombarding an isotope of the element americium with alpha particles in a cyclotron. Richard L. Hahn

See also **Seaborg, Glenn T.; Transuranium element.**

Berkman, Alexander. See **Goldman, Emma.**

Raga, The Stock Market

The Brandenburg Gate, a famous symbol of Berlin, stands between the city's two downtown areas. The gate's huge stone colonnade was completed in 1791.

Berlin

Berlin is Germany's capital and largest city. It has a population of about $3\frac{1}{2}$ million and is one of Europe's great cultural, political, and economic centers.

Berlin developed as a trading village about A.D. 1200. Over time, its location at the junction of the Spree and Havel rivers—a trading crossroads—helped to establish its importance. In the 1600's, Berlin became the capital of Prussia, an emerging German state. Two centuries later, in 1871, Berlin became the capital of the new nation of Germany.

Berlin's darkest period began with the rise to power in Germany of Adolf Hitler and the Nazi Party in 1933. During World War II (1939-1945), Germany and other Axis powers fought the Allies, who included Britain, France, the Soviet Union, and the United States. Berlin was wrecked by Allied bombs and the Soviet Army.

After Germany's defeat in 1945, the victorious Allies divided the nation into two *sectors* (districts), Communist East Germany and non-Communist West Germany. Berlin was divided into Communist East Berlin and non-Communist West Berlin. East Berlin became the capital of East Germany. Bonn was made West Germany's capital. The divided city played an important role in the Cold War, a power struggle between Communist and non-Communist nations. In 1961, during the Cold War period, the Communist East German government blocked access from East Berlin to democratic West Berlin by building the Berlin Wall, a high, heavily guarded barrier.

Lutz Holzner, the contributor of this article, is Professor of Geography at the University of Wisconsin at Milwaukee.

In 1989, the East German government collapsed, and the Berlin Wall was knocked down, symbolizing the end of the Cold War. In 1990, East and West Germany reunited, and the two Berlins merged to become one city. Berlin became the official capital of united Germany.

The city

Berlin covers an area of 341 square miles (883 square kilometers), and the entire metropolitan area lies within the city limits. The city has a diverse and, for Europe, unusually open urban landscape. Within the city limits lie many parks, lakes, gardens, and forested areas, and some open farmland. Berlin's outer districts resemble the suburbs of many large European and North American cities. Outside the city limits are rural areas and mostly flat, sandy countryside.

The downtown areas. Two main downtown areas emerged in Berlin after the city was divided in the late 1940's. One of them, in the administrative district called the Mitte (Center), had been the city's original downtown area. Before World War II, this section of the city was the wealthiest area in Germany and the heart of Berlin's business, cultural, and political life. It included Germany's most important banking district and the headquarters of Germany's leading book and newspaper publishers. This section also was the seat of government for the German Empire, formed in 1871, and the Nazi regime.

The Mitte was severely damaged in World War II and afterward became part of East Berlin. The East German government rebuilt the Mitte as downtown East Berlin.

Many of the Mitte's cultural buildings cluster around a boulevard called Unter den Linden (Under the Linden Trees). They include the German State Library, German State Opera House, and Humboldt University. A nearby

Martzik, Bavaria

The Kaiser Wilhelm Memorial Church consists of two modern structures on either side of a ruined tower left standing as a reminder of the destruction caused by World War II.

island in the Spree River called Museum Island has many world-famous museums and art collections.

A new downtown emerged west of the old one after World War II. Wide new boulevards, tall buildings, and sprawling parks replaced the war ruins in this area, which became downtown West Berlin. Many department stores and banks are in the western downtown, along with hotels, cultural institutions, and theaters.

The most famous avenue in the western downtown area is Kurfürstendamm, an elegant shopping boulevard. At the east end of the Kurfürstendamm stands the Kaiser Wilhelm Memorial Church. The modern church building and a bell tower stand on either side of the original bombed-out tower, left standing as a reminder of World War II. Other landmarks in downtown West Berlin include Ernst-Reuter-Platz, one of Europe's largest public squares; a railway station called the Bahnhof Zoo; and the Hansa Quarter, an area of houses, apartment buildings, and other structures designed in the 1950's by leading architects from all over the world.

Facts in brief

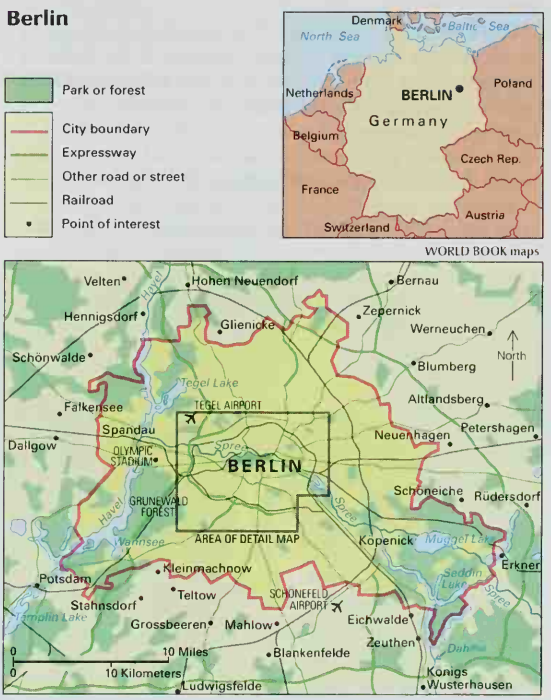
Population: 3,433,695.
Area: 341 sq. mi. (883 km²).
Altitude: 115 ft. (35 m) above sea level.
Climate: *Average temperature*—Jan., 35 °F (2 °C) July 74 °F (23 °C). *Average annual precipitation* (includes rainfall and snowfall)—23 in. (58 cm). For the monthly weather in Berlin, see **Germany** (Climate).
Government: *Legislative*—House of Representatives of about 240 members, elected by the people (four-year terms). *Chief executive*—governing mayor elected by the House of Representatives (four-year term).
Founded: About A.D. 1200.

Between the two downtown areas stands a famous symbol of Berlin called the Brandenburg Gate—in German, *Brandenburger Tor*. The gate's main part is a huge stone colonnade completed in 1791. Prussian armies paraded through it after returning from victorious military campaigns.

Residential areas of Greater Berlin vary widely in population density, in their type of housing, and in the social and economic status of their residents. The city's inner districts are much more densely populated than its outer ones. In the inner districts, including both downtown areas, most people live in crowded, multistory apartment buildings. Housing in some outer districts consists mainly of comfortable single-family homes and modern condominiums. The outlying districts also have large housing projects.

Since the 1940's, a shortage of housing has been a major problem. Air raids and ground fighting during World War II destroyed or severely damaged about one-third of all housing units. Some low-quality apartment buildings from the 1800's and 1900's survived the war. These buildings are now run-down, and many lack private bathrooms. Since reunification, immigration to Berlin has increased, worsening the housing problem. Thousands of Berliners are homeless. Some of them live in camping trailers, old construction huts, and tents gathered in squatter slums called *Wagen-Dörfer* (wagon villages) near the site of the old Berlin Wall.

Industrial areas are scattered throughout Berlin. Most large manufacturing plants are in the city's outlying districts. The largest firms operate near the main rail lines and along canals and the Spree and Havel rivers.



Berlin, Germany's largest city, lies at the junction of the Spree and Havel rivers in the northeastern part of the country.

People

Ethnic groups and religion. Citizens of other countries make up about one-tenth of Berlin's population. Many of these non-Germans arrived as *guest workers,* laborers who came to find jobs. About half the guest workers are Turkish. Foreigners also came from Greece, Italy, Poland, Russia, the United States, the former Yugoslavia, and various African and Asian nations.

The population of Berlin has grown rapidly since the end of World War II, when it had dropped to only 2,300,000. Factors contributing to the population growth included the return of residents evacuated during the war and a flow of East Germans into East Berlin. The large number of foreigners immigrating to the city also increased the population. Since the unification of the two Germanys, hundreds of thousands of newcomers have poured into the city.

About 75 percent of Berliners are Protestant, mostly Lutheran. Roman Catholics make up about 10 percent of the population. Several other religions are practiced by small segments of the population.

The arts. Berlin is a world-renowned center of culture. Its festivals and exhibits attract thousands of visitors each year. More than 50 nations take part in the Berlin Film Festival every year in February. Each September, the Berlin Festival Weeks highlight the start of the concert, opera, and theater season. Berlin has several major theaters, including the German Opera, Theater am Kurfürstendamm, German Theater, State Opera, and Comic Opera. The city is famous for its *cabarets,* cafes that offer entertainment, including political skits and comic songs. The Berlin Philharmonic Orchestra is one of the world's finest orchestras.

Libraries and museums. Important museums in Berlin include a group of state museums in the Dahlem district, among them a painting gallery and an anthropological museum. Museum Island has the National Gallery; the Pergamon Museum, which houses the famous classical Greek Pergamon Altar; and the Bode Museum. Other museums are scattered throughout the city.

Berlin has several important libraries. The German State Library is the world's largest German-language library. Other major libraries include the American Memorial Library and the libraries at Humboldt University, Free University, and Technical University.

Education. Berlin has the largest number and greatest variety of institutions of higher learning and research anywhere in Germany. Besides the three major state universities, there are several academies of music and art and private colleges. Other schools specialize in architecture, dance, education, film, and medicine.

Berlin is not only a city but also a state of Germany and controls its own public education system. All public schools in Berlin, including the state universities, are free. Kindergarten is available to all children ages 3 through 5, followed by six years of elementary school through age 11. After elementary school, students must then choose one of three secondary school tracks: (1) a four-year program to prepare for a trade; (2) a four-year program leading to a job in engineering or another technical field; and (3) a seven-year program to prepare for a university.

Recreation. Outdoor recreation and sports play an important role in the lives of Berliners. The city's many rivers, waterways, and lakes provide opportunities for boating and fishing, and are known for their large, well-kept beaches.

The Grunewald, a large forest along the Havel River, has riding and hiking paths, picnic areas, and playgrounds. Teufelsberg (Devil's Mountain) is an artificial hill in the Grunewald used for rock climbing, skiing, and sledding. It was built from rubble left after World War II. Many parks are scattered throughout Berlin. One of the city's largest parks, a former game reserve called the Tiergarten (Animal Garden), covers 630 acres (255 hectares) in the western downtown area. The Tiergarten has a zoo and an aquarium.

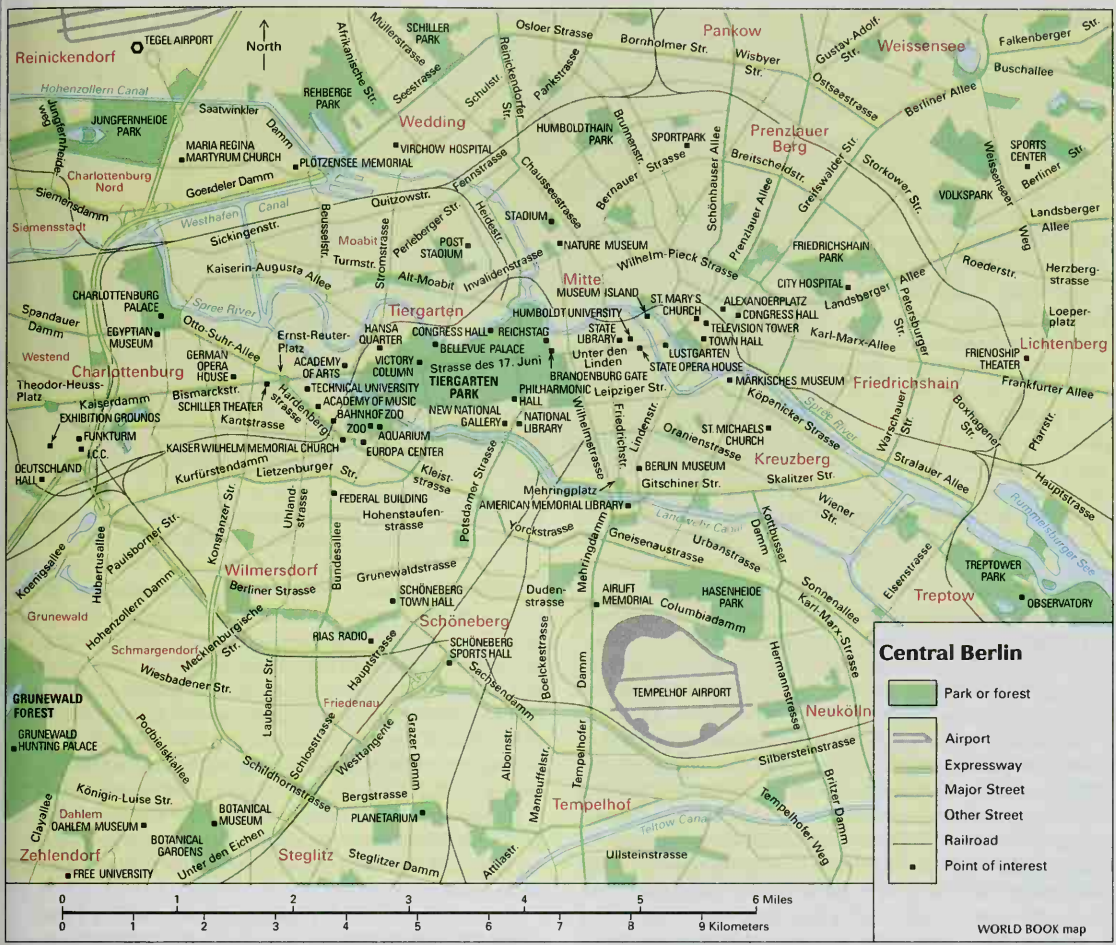
Many soccer matches are played in the Olympic Stadium near the Grunewald. The stadium, built for the 1936 Olympic Games, seats about 100,000 spectators.

Economy

Before World War II, Berlin had been Germany's most important industrial and trading center. After the city was divided in the late 1940's, West Berlin adopted a

Damm, ZEFA

Berlin's many parks, lakes, and rivers provide opportunities for recreational activities. In this photograph, a boat sails near an island in the Havel River.



free enterprise economy, and the economy of East Berlin came under government control. Aid from the United States and West Germany helped bring rapid recovery in West Berlin. Continued West German aid enabled West Berlin to prosper despite its geographic isolation. The economy of East Berlin lagged by comparison.

Before the Berlin Wall was built in 1961, millions of East Germans fled to West Berlin or to West Germany. Others continued to live in East Berlin but worked in West Berlin. Communist officials had difficulty rebuilding East Berlin and developing its economy because so few skilled people remained. After the wall was built, production rose and conditions improved in East Berlin. However, low wages, high prices, government central planning, and limited availability of consumer goods resulted in a much lower standard of living for East Berliners than for West Berliners.

In November 1989, the East German government opened the Berlin Wall and announced sweeping economic reforms, including the sale of government-owned businesses to private citizens. In July 1990, the economies of East and West Germany united. Unprofitable businesses have been closed, and thousands of workers have been laid off. For more information on the economic union of East and West Germany, see **Germany** (Economy).

Industries. Berlin is an important German manufacturing center. Manufacturing provides jobs for about half of the city's workers. Berlin's leading industries are the manufacture of electrical products, chemicals, clothing, and machinery. Food processing is also an important industry in the city. The other half of Berlin's labor force is employed in service industries such as government, finance, and retail trade.

Transportation and communication. The Berlin area has two major civilian airports—Tegel and Schönefeld. Railways connect Berlin with many parts of Europe. Canal systems link the city with Germany's main waterways and with a number of ports, including Hamburg on the North Sea. Berlin has an excellent public transportation system that includes buses, commuter trains, and streetcars. Its well-known S-Bahn (a rapid transit line called the *Schnellbahn*) and U-Bahn (a subway and ground-level train known as the *Untergrundbahn*) carry passengers to most parts of the city.

Berlin has about 10 daily newspapers. The largest are *B. Z.* (short for *Berliner Zeitung,* formerly of West Berlin) and another paper known by the full name *Berliner Zei-*

tung (formerly of East Berlin). Several television and radio stations as well as satellite and cable TV systems serve the city.

Government

The city of Berlin, also called *Greater Berlin* (in German, *Gross Berlin*), consists of 23 administrative districts. The people of Berlin elect about 240 members to a legislature called the Abgeordnetenhaus (House of Representatives). The House members make the city's laws. They also elect the governing mayor, who is the government's chief executive. Both the governing mayor and members of the House serve four-year terms. The governing mayor appoints a deputy mayor and a cabinet called the Senate with approval of the House. These officials direct the government departments.

In addition to being the capital of Germany, Berlin is also one of the country's 16 states. The people of Berlin elect 28 representatives to Germany's Bundestag (larger house of parliament). Berlin also has four votes in the other house of parliament, the Bundesrat.

History

Early days. About 1,500 years ago, various Slavic peoples lived in the area of present-day Berlin. During the A.D. 900's, German emperors in western Europe extended the boundaries of their territories to the Oder River, just east of Berlin. German settlers began to occupy the new region in the 1100's.

The village of Berlin grew up on the northeast bank of the Spree River. About the same time, the village of Kölln (or Cölln) was founded on an island in the Spree. Historians do not know exactly when the villages were founded, but Kölln was first mentioned by name in a document in 1237 and Berlin in 1244. Both were trading centers. In 1307, Berlin and Kölln established a union for their joint defense and built a common town hall.

By the 1400's, Berlin had become an important town in the German state of Brandenburg. The Hohenzollern family, who ruled Brandenburg, made Berlin their official home in the late 1400's. The Thirty Years' War, from 1618 to 1648, brought great misery to Berlin. The town was forced to house and pay for troops. In addition, Berlin was stricken by epidemics, and its suburbs were burned. By the end of the war, Berlin's population had fallen to 6,000, about half its former size.

Prussian capital. Berlin prospered again under the Great Elector, Frederick William, one of the Hohenzollern family. He ruled Brandenburg from 1640 to 1688. He encouraged industries and sponsored building projects. During his reign, the first canal was built between the Spree and the Oder rivers. His son Frederick I became the first king of Prussia in 1701 and made Berlin his capital. In 1710, Berlin, Kölln, and three neighboring communities united as the city of Berlin.

During the 1700's, Berlin grew from a small town to a thriving trading and manufacturing center. The arts and sciences flourished, and industry expanded rapidly. The French armies of Emperor Napoleon I occupied Berlin from 1806 to 1808. After they left, the city prospered as the capital of Prussia, which had become a leading German power. When the German Empire was formed in 1871, Berlin became its capital. The city's population rose from 826,000 in 1871 to 2,076,200 in 1910.

WORLD BOOK map

Berlin was divided into American, British, French, and Soviet *sectors* (districts) after World War II ended in 1945. The American, British, and French sectors became known as West Berlin. The Soviet sector became known as East Berlin.

Years of unrest. The German Empire collapsed at the end of World War I in 1918, and Berlin became the capital of Germany's new Weimar Republic. Strikes, riots, and inflation plagued the city during the postwar years. But Berlin continued to grow. In 1920, 7 cities, 59 villages, and 27 estates were annexed into Berlin. The 7 cities, which are now residential neighborhoods of Berlin, were Charlottenburg, Köpenick, Lichtenberg, Neukölln, Schöneberg, Spandau, and Wilmersdorf.

Berlin was hard hit by the worldwide economic depression of the 1930's. Hunger, unemployment, and widespread discontent paved the way for Adolf Hitler to seize power in 1933.

World War II nearly wiped out Berlin. About a third of the city was destroyed, and some 152,000 civilians lost their lives. The damage and deaths resulted mostly from Allied bombing raids throughout the war, and from an extended land battle for Berlin in 1945.

The victorious Allies took over Berlin in 1945 and divided the city into four sectors. Britain, France, the Soviet Union, and the United States each occupied one sector. They also divided Germany into four zones.

The Soviet blockade. Although Berlin lay within the Soviet zone of occupation, the Western powers expected the Soviet Union to permit them free access to the city. However, in June 1948, the Soviet Union blocked all rail, water, and highway routes through the Soviet zone to the Western sectors of Berlin.

The Soviets hoped the blockade would drive Western troops out of Berlin. But Western nations organized a gigantic airlift to supply West Berliners with needed goods. At the height of this project, called the Berlin Airlift, planes landed in West Berlin at the rate of one every one to two minutes. General Lucius D. Clay, the commander of the U.S. armed forces in Europe, directed the airlift. The Soviets finally ended the blockade in May 1949, and the airlift stopped that September.

A divided city. In late 1948, East and West Berlin established separate governments. Each city had its own police, currency, and public utilities systems. In 1949, the three Western zones of Germany were combined as

© Robert Wallis, Sipa Press

The Berlin Wall was opened in 1989. It had been built in 1961 to halt escapes from East Berlin to West Berlin. The historic opening included the removal of parts of the wall, *shown here.*

West Germany, and the Soviet zone became East Germany. East Berlin became East Germany's capital. Bonn was made West Germany's capital. During the 1950's, travel between the two parts of Berlin was generally unrestricted. As a result, West Berlin became a way for thousands of East Germans to escape Communism.

The Berlin Wall. By 1961, more than 1,000 East Germans were fleeing to West Berlin every day. On Aug. 13, 1961, East German police began building a wall of concrete and barbed wire to divide the two parts of the city. Some East Germans escaped to West Berlin after the Berlin Wall was built, but more than 170 people died trying to escape. Most of those who died were shot by border guards. Lying deep within Communist East Germany, West Berlin was an isolated outpost of democracy and faced constant threats of cutoffs of supplies.

In 1971, the United Kingdom, France, the Soviet Union, and the United States signed an agreement on the status of Berlin. The pact stated that West Berlin was not part of West Germany. But it also provided for political and economic ties and free movement between West Germany and West Berlin. During the 1970's and 1980's, relations between East and West Berlin improved slightly.

A united Berlin. In 1989, large numbers of East Germans fled to West Germany by way of Hungary, Czechoslovakia, and Poland. Meanwhile, widespread demonstrations demanding greater freedom broke out in East Germany. In November 1989—in response to the protests—the East German government ended all restrictions on travel and emigration by East Germans. As a result, the 28-year-old Berlin Wall was opened.

In March 1990, in free elections in East Germany, non-Communists won control. In October, East and West Germany united into a single nation. Berlin was declared the capital, but Bonn continued to function as the capital. In 1991, the German Parliament voted to move most government offices and activities to Berlin.

One of Berlin's major challenges in the 1990's was to generate greater public revenue and taxes. After reunification, Berlin acquired many of East Berlin's economic problems. As a result, funds were needed for public housing, education, unemployment compensation, higher wages, pensions, social security, and health benefits. Many believed that an increase in government jobs resulting from Berlin's restored role as Germany's capital would help invigorate the economy.

East Berliners hoped a reunified city would achieve the former West Berlin standard of living. But this goal led to conflicts among social and political groups. In 1993, a strike by steelworkers in eastern Germany, including the former East Berlin, won a gradual increase of wages to western German levels.

Recent developments. In 1999, many government offices moved from Bonn to Berlin. The Reichstag, the parliament building of both the German Empire and the Nazis, became the new home of the Bundestag. In 2001, the new offices of Germany's chancellor opened in Berlin. New government buildings stand where the eastern and western downtowns once met, thus symbolically linking the previously divided city.

Lutz Holzner

Related articles in *World Book* include:

Berlin Airlift
Berlin Wall
Brandt, Willy
Cold War (The Berlin blockade)
Germany
Kennedy, John F. (Berlin)
Prussia

Outline

I. The city
- A. The downtown areas
- B. Residential areas
- C. Industrial areas

II. People
- A. Ethnic groups and religion
- B. The arts
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- D. Education
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III. Economy
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V. History

Questions

What are the leading industries of Berlin?
What was the Soviet blockade? The Berlin Airlift?
What is the Tiergarten?
How did the Thirty Years' War affect Berlin?
What challenges does Berlin face today?
Why did the Communists build a wall across Berlin in 1961?
How do Berlin's inner districts differ from its outlying ones?
Who is the chief executive of Berlin's government?
How much of Berlin was destroyed in World War II?
What are some cultural events for which Berlin is famous?

Additional resources

Berlin. Dorling Kindersley, 2000. A travel guide.
Large, David C. *Berlin.* Basic Bks., 2000.
Richie, Alexandra. *Faust's Metropolis: A History of Berlin.* Carroll & Graf, 1998.
Taylor, Ronald. *Berlin and Its Culture.* Yale, 1997.

Berlin, Congress of, was a meeting of European leaders in 1878 to decide the future of the Balkans, a region controlled by the Turkish-based Ottoman Empire that included present-day Albania and Bulgaria and much of what became Yugoslavia. Leaders from Germany, Austria, France, the United Kingdom, Italy, Russia, and the Ottoman Empire attended the meeting. Otto von Bismarck, Germany's chancellor, served as chairman.

The problems facing the meeting grew out of the Ottoman Empire's defeat by Russia in the Russo-Turkish War, which had just ended with the signing of the Treaty of San Stefano. Under this treaty, the Ottomans would have to give up most of their land in the Balkans. The country of Bulgaria would be created, and Russia would have been chosen to protect the peace. The other important countries of Europe, however, did not want Russia to acquire a controlling influence in the region.

The decisions of the congress changed most of what Russia had put into the Treaty of San Stefano. Northern Bulgaria was made a self-governing Ottoman province. Southern Bulgaria, then called Eastern Rumelia, became a partly self-governing Ottoman province. Western Bulgaria, including much of Macedonia, went back to the Ottoman Empire. Austria gained the right to rule Bosnia-Herzegovina. Montenegro, Serbia, and Romania were made independent. Cyprus was given to Britain to protect the Suez Canal and the sea lanes to India. Russia got a strip of Bessarabia and land in the Caucasus region.

The Congress of Berlin resulted in shifts in alliances. Germany and Austria became allies in 1879, and Russia joined them in 1881. The congress also left bitterness among some nations and failed to solve the Balkan problem, which led to the outbreak of World War I in 1914. Diane Shaver Clemens

See also **Russo-Turkish wars.**

Berlin, Irving (1888-1989), composed many of the most famous American popular songs. Berlin wrote the music and lyrics for romantic ballads, humorous songs, and patriotic anthems. He was the songwriter most able to reflect changes in America's taste in popular song. His hits include "Easter Parade," "God Bless America," and "A Pretty Girl Is Like a Melody." Berlin won an Academy Award for his song "White Christmas" from *Holiday Inn* (1942). See **God Bless America.**

Berlin was born in Russia. His real name was Israel Baline. His family moved to New York City in the early 1890's. Berlin went to school for only two years and was a self-taught musician. Berlin wrote his first successful song, "Alexander's Ragtime Band," in 1911. This song combined quotations from American folk music with a suggestion of the *syncopation* of ragtime. In syncopated music, normally unaccented beats are accented. Berlin thus helped popularize a musical style free of European influences that had dominated American music.

From about 1910 to the early 1930's, Berlin wrote songs for many Broadway musicals. Much of this music was written for variety shows called *revues.* Berlin's best-known Broadway shows included the annual *Music Box Revues,* presented from 1921 to 1924.

In 1935, Berlin moved to Hollywood, California, where he wrote songs for a number of motion-picture musicals, including *Top Hat* (1935), *Follow the Fleet* (1936), and *Carefree* (1938), which all starred Fred Astaire and Ginger Rogers. His hit tunes for the movies include "Cheek to Cheek" and "Let's Face the Music and Dance." Berlin later moved back to New York City. He composed the songs for the Broadway musical *Louisiana Purchase* (1940). Berlin's most highly praised musical was perhaps *Annie Get Your Gun* (1946), which features such songs as "Anything You Can Do," "Doin' What Comes Naturally," "There's No Business Like Show Business," and "They Say It's Wonderful." Other musicals by Berlin include *The Cocoanuts* (1925), *Face the Music* (1932), *As Thousands Cheer* (1933), *This Is the Army* (1942), *Miss Liberty* (1949), and *Call Me Madam* (1950). Berlin also wrote individual compositions. Among the most popular are "All Alone," "Always," "Blue Skies," "Say It Isn't So," "How Deep Is the Ocean?", and "Remember." Ken Bloom

Additional resources

Bergreen, Laurence. *As Thousands Cheer: The Life of Irving Berlin.* 1990. Reprint. Da Capo, 1996.
Hamm, Charles. *Irving Berlin: Songs from the Melting Pot.* Oxford, 1997.
Jablonski, Edward. *Irving Berlin: American Troubadour.* Henry Holt. 1999.

Berlin Airlift was the historic effort by which France, the United Kingdom, and the United States supplied West Berlin entirely by air during a Soviet blockade. The airlift lasted from June 1948 to September 1949. It delivered food, coal, petroleum, and other supplies to over 2 million people in West Berlin. The airlift, which saved West Berliners from starvation, ranks among the most important and dramatic incidents of the early Cold War.

After World War II ended in 1945, Germany was divided into East Germany, controlled by the Soviet Union; and West Germany, occupied by France, the United Kingdom, and the United States. The city of Berlin was also divided, its eastern section controlled by Soviet Communists and its western part by the three Western powers. Berlin lay well within East German territory. The Western powers generally brought supplies to West Berlin by way of trucks or railroad cars.

As Cold War tensions mounted, the Soviets decided to block all highway, rail, and water traffic through East Germany to isolate West Berlin. The blockade was an attempt to drive the Western powers out of the city. However, the Soviet Union had to lift its blockade in May 1949. The airlift continued until September. American and British airplanes made more than 250,000 flights and delivered more than 2 million tons (1.8 million metric tons) of supplies to West Berlin. James J. Sheehan

See also **Cold War** (picture: The Berlin Airlift).

Berlin Conference was a meeting of 14 nations to discuss territorial disputes in Africa. The meeting was held in Berlin, Germany, from November 1884 to February 1885 and included representatives from the United States and such European nations as the United Kingdom, France, and Germany. No Africans were invited.

The Berlin Conference took place at a time when European powers were rushing to establish direct political control in Africa. This race to expand European colonial influence is often referred to as the "Scramble for

Africa." Europeans called the Berlin meeting because they felt rules were needed to prevent war over claims to African lands.

The Berlin Conference adopted a number of provisions. For example, it ruled that European nations could not just claim African territory but had to actually occupy and administer it. It also declared that a nation already holding colonies on the African coast would have first claim on the neighboring interior. Rivers in Africa were to be open to all ships, not just those of the colonial power through whose land the river ran. Slavery and slave trading were to end in all European colonies. The conference also recognized the Congo Free State—now Congo (Kinshasa)—as a country, with Belgium's King Leopold II as its ruler. Acting as a private citizen, Leopold had claimed the area in 1878. Robert Garfield

Berlin Wall was built in 1961 to divide the two parts of the city of Berlin—Communist East Berlin and non-Communist West Berlin. Berlin lay deep in Communist East Germany, but the Western allies of West Germany controlled West Berlin. East Germany, backed by the Soviet Union, built the Berlin Wall to prevent East Germans from emigrating to the West. In 1989, widespread demands for more freedom took place in East Germany. In response, the East German government ended its restrictions on emigration and travel to the West by its citizens. The East Germans opened the wall in November and soon began to tear it down. In October 1990, East and West Germany were united into the single non-Communist country of Germany. Berlin was reunited into a single city. By 1992, nearly all the Berlin Wall had been removed. Several sections will remain standing as memorials, but most of it was broken up for use in roadbeds and other construction projects. Parts of the wall were sold to museums and private individuals.

The Berlin Wall was constructed as a system of heavily fortified barriers that was about 26 miles (42 kilometers) long. It included a wall of massive concrete slabs that varied from 12 to 15 feet (3.7 to 4.6 meters) in height. Pipes, barbed wire, and other obstacles were installed on top of much of the wall. Before the wall was opened in 1989, the East Berlin side included armed guards, guard dogs, barbed wire, electric alarms, mines, and trenches. Walls and other barriers were also built around the rest of West Berlin. The length of the barriers totaled about 110 miles (160 kilometers).

Before 1961, large numbers of East Germans chose to leave their country to escape Communist rule and seek freedom and a better living standard in the West. Many left by simply crossing into West Berlin from East Berlin. The Communists built the Berlin Wall to stop this emigration. The barriers around West Berlin and along the East German-West German border made escape to the West extremely difficult. More than 170 people died trying to escape from East Germany by crossing over the Berlin Wall. Most of them were shot by border guards. The opening of the Berlin Wall in 1989 was hailed as a historic event that symbolized the collapse of Communism in Eastern Europe. Melvin Croan

See also **Berlin** (History; picture); **Cold War** (The Berlin Wall).

Berliner, *BUR luh nuhr,* **Emile** (1851-1929), invented a practical telephone transmitter in 1877. In 1887, he also developed the first successful phonograph that used disk-shaped records. Berliner developed a telephone transmitter in which sound, such as that made by the human voice, varied the strength of an electric current. These variations caused a telephone receiver to reproduce the original sound. Berliner also invented a way to press duplicate records from one master disk (see **Phonograph** [History]). He was born in the kingdom of Hanover, in what is now Germany, and came to the United States in 1870. James E. Brittain

Berlioz, *BAIR lee ohz,* **Hector,** *ehk TAWR* (1803-1869), was a French composer. He is known for his orchestrating genius; his long, uninterrupted melodies; and his way of relating his musical compositions to stories and ideas, called *program music.* He drew from life experiences for many of these programs. His understanding of acoustics enabled him to become a great orchestrator.

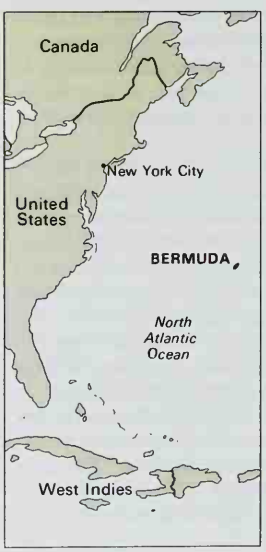
Berlioz chiefly composed symphonies, operas, and other large works. Virtually all of these works had a text or program. His symphonies include the *Symphonie fantastique* (1830); *Harold in Italy* (1834), with viola solo; and *Romeo and Juliet* (1839), with solo voices and chorus. He composed five operas, including *Benvenuto Cellini* (1838), *Beatrice and Benedict* (1862), and *The Trojans* (1863, 1890). His other works for soloists, chorus, and orchestra include the *Requiem* (1837), *L'Enfance du Christ* (1854), and *The Damnation of Faust* (1846).

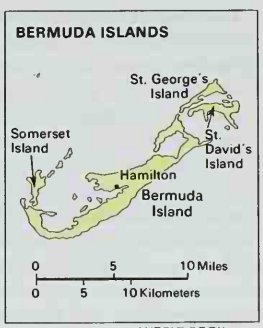
Berlioz was admired as a conductor, critic, and writer. His books on music include *Grand Treatise on Modern Instrumentation and Orchestration* (1844), *Evenings with the Orchestra* (1852), and *The Conductor: The Theory of His Art* (1855). His *Memoirs* were published in 1870, after his death. Louis Hector Berlioz was born in La Côte Saint-André, near Grenoble. Stewart L. Ross

See also **Classical music** (picture: Hector Berlioz).

Bermuda, *buhr MYOO duh,* an overseas territory of the United Kingdom, is a group of coral islands and islets in the Atlantic Ocean. It is a popular resort center.

Location, size, and description. Bermuda consists of more than 300 islands and tiny islets, only 20 of which are inhabited. The islands form the most northerly group of coral islands in the world. They lie midway be-





WORLD BOOK maps

Bermuda lies off the eastern coast of North America, about 670 miles (1,080 kilometers) from New York City. The smaller map shows the main islands of Bermuda.

Bermuda News Bureau

Vacationers in Bermuda enjoy the islands' beautiful beaches, palm trees, and mild climate. Bermuda attracts hundreds of thousands of tourists every year.

tween Nova Scotia and the West Indies, about 670 miles (1,080 kilometers) from New York City. The largest islands are Bermuda, St. George's, St. David's, and Somerset. These islands and several smaller islands are linked by bridges. Bermuda's total area is about 21 square miles (53 square kilometers). The four largest islands extend in a chain that is about 22 miles (35 kilometers) long. The island of Bermuda occupies about two-thirds of the total area. Hamilton, the capital, is on this island.

Bermuda has hills and ridges that rise as high as 260 feet (80 meters) above sea level. The hills add to the beauty of Bermuda, which is noted for winding roads, palm trees, colorful flowers, and shining beaches.

Bermuda has few sources of fresh water. Rain water is caught on the roofs of buildings and stored in tanks under the buildings. Roofs are kept clean and whitewashed to help keep the water supply pure.

Bermuda's annual rainfall averages 58 inches (147 centimeters). The average yearly temperature is 70 °F (21 °C). Fall hurricanes may strike the islands.

Education. Bermuda provides free primary and secondary education. Children aged 5 through 16 are required to attend school. Bermuda's Warwick Academy, founded in 1626, is believed to be the oldest secondary school in the Western Hemisphere. Bermuda College provides higher education.

The people and their work. The 20 inhabited islands have a population of about 63,000, not including about 15,000 British and United States military personnel. Blacks make up about 60 percent of the population, and whites about 40 percent. Tourism is the major source of income. Bermuda's mild climate and excellent hotels, beaches, and recreational resources attract about 500,000 tourists every year. Bermuda has long been a favorite honeymoon spot. Golf, bicycling, fishing, sailing, and tennis are popular sports. About 300 species of fish can be found in nearby waters. Devil's Hole is a natural fish pond. Other attractions include caves, and old forts and other historic buildings. St. Peter's Church in St. George, on St. George's Island, dates from 1619. Tourists can buy British goods, such as fine china and woolen fabrics, at low prices.

Bermuda attracts businesses from other countries by providing tax exemptions. About 7,000 foreign companies operate in Bermuda. They include many insurance and investment firms. The overseas territory ranks as one of the world's leading centers of the insurance business. Bermuda has relatively little farmland, and it must import about four-fifths of its food.

Major harbors are located at Hamilton and at St. George. Only small cars are permitted on the islands. They may travel up to 35 kilometers (22 miles) per hour.

Government. Bermuda is a parliamentary democracy. The British Crown appoints the governor of Bermuda. An eight-member council assists the governor. Bermuda's parliament first met in 1620 and is the world's oldest British overseas parliament. It includes an 11-member appointed Senate and a 40-member elected House of Assembly. Senate members serve three-year terms and House of Assembly members, up to five-year terms. From 1797 until the 1950's, Britain kept garrisons in Bermuda for protection. The North Atlantic Treaty Organization now provides for Bermuda's defense.

History. The Bermuda Islands were named for Juan de Bermúdez, a Spaniard, who discovered them early in the 1500's. The *Sea Venture,* a ship carrying colonists to Virginia, was destroyed at sea near the islands during a storm on July 28, 1609. For a time, the colony was called *Somers Islands* after Admiral Sir George Somers, the captain of the *Sea Venture.* The town of St. George was also named in his honor. The reef on which the ship crashed still bears the name of *Sea Venture.* Bermudians celebrate Somers Day on July 28. The passengers of the *Sea Venture* remained for a time, but all except two of the group sailed to Virginia in 1610. These two became Bermuda's first permanent settlers. The others found the Jamestown settlers near starvation. Somers returned to Bermuda for supplies but died a few days after his arrival. His ship left another settler and returned to Virginia.

King James I of England awarded Bermuda to the Virginia Company, about 1610. The company sold its rights in 1613 to a group of English merchants. In 1684, the English Crown took over the administration of the islands. St. George served as the capital until the seat of government was moved to Hamilton in 1815.

English settlers in Bermuda kept black Africans as slaves. But the slaves did not work on plantations, as they did in Caribbean countries and in the Southern United States. Instead, they worked as domestic servants and performed various crafts, such as boatbuilding.

During the 1800's, Bermuda carried on a thriving merchant trade with the West Indies and the North American continent. The salvage of ships destroyed by storms in nearby waters also contributed to Bermuda's income. After Gibb's Hill Lighthouse was erected in 1846, fewer shipwrecks occurred. The lighthouse still stands near Port Royal Bay. Blockade-running for the Confederacy became profitable during the Civil War. Some Bermudians made fortunes as privateers. During the Prohibition period in the United States (1920-1933), some Bermudians smuggled alcoholic beverages into U.S. ports on the Atlantic Coast.

Bermuda was the site of a U.S. naval base during World War I and of U.S. air and naval bases during World War II. Today, a U.S. Navy base operates about

2 miles (3 kilometers) south of St. George. It also serves as a commercial airfield called Kindley Field.

Bermuda's economy and government are controlled by the white minority. During the late 1960's and the 1970's, many blacks protested against this control. The protests included outbreaks of violence. In 1973, the governor of Bermuda, Sir Richard Sharples, a white, was assassinated. A black rebel confessed to the assassination and was convicted. He was hanged in 1977.

As in the past, blacks today hold most of the lowest paying jobs in Bermuda. But their political power has grown since the 1970's. Racial relations in Bermuda have also improved since the 1970's. Gary Brana-Shute

See also **Hamilton.**

Bermuda Triangle, *buhr MYOO duh,* also called Devil's Triangle, is an area of ocean off the southeastern coast of Florida where many ships and airplanes have disappeared. However, commercial and military craft cross this area safely every day.

Many people believe the disappearances have taken place under mysterious circumstances. Only a few captains or pilots radioed distress messages. Searchers seldom found bodies or survivors, though bits of wreckage were recovered after several disappearances.

Some scientists believe that violent, unexpected storms or downward air currents destroyed the ships and planes. Swift ocean currents may then have swept the wreckage far from where the craft disappeared.

The Bermuda Triangle covers about 440,000 square miles (1,140,000 square kilometers). It is formed by an imaginary line drawn from a point near Melbourne, Florida, to Bermuda to Puerto Rico and back to Florida.

The first recorded disappearance of a United States ship in the Bermuda Triangle occurred in March 1918, when the U.S.S. *Cyclops* vanished. On Dec. 5, 1945, a squadron of five U.S. bombers disappeared, and a seaplane vanished while searching for the aircraft.

Philip Chadwick Foster Smith

Additional resources

Kusche, Lawrence D. *The Bermuda Triangle Mystery Solved.* Rev. ed. 1986. Reprint. Prometheus, 1995.

Oxlade, Chris. *The Mystery of the Bermuda Triangle.* Heinemann Lib., 1999. Younger readers.

Bern (pop. 136,338; met. area pop. 332,494), also spelled *Berne,* is the capital of Switzerland and the Swiss *canton* (state) of Bern. The city lies along the Aare River in west-central Switzerland (see **Switzerland** [political map]).

The city. Bern is one of Europe's most charming cities. Its carefully maintained central section has many buildings that are hundreds of years old. Some of the buildings have *arcades.* These arched structures over the sidewalks provide shelter for pedestrians and shoppers. Picturesque fountains, some of which date from the 1500's, stand in the streets and squares of central Bern. The Zeitglockenturm, a clock tower built in 1530, is a well-known landmark. Mechanical wooden figures, including dancing bears and a knight in armor, perform each time the clock strikes the hour.

Other historic structures in central Bern include a Gothic cathedral, begun in 1421; and the city hall, built during the 1400's. The Swiss parliament buildings stand to the west. A pit in which bears are kept is to the east. Bears are symbols of the city. The name *Bern* comes from *Bären,* the German word for *bears.*

P. J. Sharpe, Shostal

Bern is one of Europe's most picturesque cities. An ornate fountain, *foreground,* stands in the central part of the city near the Zeitglockenturm, a clock tower, *background.*

Modern sections of Bern lie beyond the central section. These areas include residential districts, several museums, and a university.

The Bernese Oberland, a part of the canton of Bern, lies south of the city. This area is world famous for its magnificent scenery, notably the towering mountains of the Alps system and beautiful valleys and lakes.

Economy. The Swiss government is a major employer in Bern. Many people work in light industry, especially in the manufacture of precision tools. Swiss watches are produced in a number of villages throughout the canton of Bern. The canton is also a center of dairy farming and chocolate making. Emmentaler, or Swiss, cheese originated in the canton. Tourism is an important source of income in the city and the canton.

History. Bern was founded in 1191 by Duke Berthold V of Zähringen. It quickly became prosperous and gained control over much of the surrounding territory. In 1353, Bern united with other Swiss areas in a political alliance called the Swiss Confederation.

The city gained more territory, and by the mid-1500's it controlled about a third of what is now Switzerland. French troops invaded Switzerland in 1798 and occupied the country for 16 years. During that period, some areas controlled by Bern were freed and became separate cantons in the Swiss Confederation. Bern became the capital of Switzerland in 1848. Heinz K. Meier

Bernadette, *BUR nuh DEHT,* **Saint** (1844-1879), is a saint of the Roman Catholic Church. She was born Bernadette Soubirous in Lourdes, France, on Jan. 7, 1844. When Bernadette was 14, the Virgin Mary is said to have appeared to the girl 18 times saying, "I am the Immaculate Conception." Lourdes became a pilgrimage center for people seeking cures. Bernadette joined the Sisters of Charity in 1866. She was declared a saint in 1933. Her feast day is April 16. See also **Lourdes.** Anne E. Carr

Bernadotte, *BUR nuh daht,* **Jean Baptiste Jules,** *zhahn bah TEEST zhool* (1763-1844), a French soldier

who became one of Napoleon Bonaparte's marshals, founded the present Swedish royal line. He was elected crown prince of Sweden in 1810. He commanded an allied army that helped defeat Napoleon at Leipzig in 1813. He ruled Sweden and Norway from 1818 to 1844 under the name Charles XIV John (Karl XIV Johan in Swedish). He was born on Jan. 26, 1763, in Pau, France.

Raymond E. Lindgren

Bernard, *behr NAHR,* **Claude** (1813-1878), the leading French physiologist of his day, founded modern experimental physiology. He studied many aspects of digestion and nerve function. Bernard discovered that the liver converts sugar to *glycogen* (animal starch), a substance used to maintain blood sugar levels. He also found that juices of the pancreas help digest and absorb fats. In addition, Bernard discovered how the nervous system controls blood circulation. His other important work included research on drugs and poisons.

Later, Bernard focused on methods of research and on the nature of living things. In his book *Introduction to the Study of Experimental Medicine* (1865), Bernard proposed a new form of experimental reasoning. He called for medical research to proceed in three stages—from observation to hypothesis to experimentation. In *Phenomena of Life Common to Animals and Plants* (1878-1879), Bernard said both living and nonliving things are subject to physical and chemical laws. He was born on July 12, 1813, in St.-Julien, France. Matthew Ramsey

Bernard of Clairvaux, *bur NAHRD uhv klair VOH,* **Saint** (1090-1153), was a Christian theologian and a leader of the Cistercian religious order. His reputation for piety and his brilliant preaching helped him influence popes and kings. He was largely responsible for the rapid expansion of the Cistercian order in the 1100's.

Bernard's writings, especially his sermons, express his ideas on theology and how to lead a Christian life. He stressed the importance of meditation and mystical experience. He urged all Christians to lead a life of poverty and self-denial modeled on the life of Jesus Christ.

Bernard was born in Fontaines-les-Dijon, France. His father was a nobleman. At the age of 22, Bernard entered the strict, newly established Cistercian monastery of Citeaux. In 1115, he founded and became head of a Cistercian monastery at Clairvaux. His influence became so widespread that his support helped Innocent II and Eugene III become popes. In 1141, he participated in the church council that condemned the theologian Peter Abelard for supposedly teaching heresy.

The high point in Bernard's career came in 1146 when Eugene placed him in charge of organizing support for the Second Crusade. Bernard's influence in European affairs declined after the crusade failed. Bernard was declared a saint in 1174. William J. Courtenay

See also Crusades (The Second Crusade); Cistercians.

Bernardin, *BUR nuh DEEN,* **Joseph Louis** (1928-1996), was appointed a cardinal of the Roman Catholic Church by Pope John Paul II in 1983. Bernardin had become archbishop of Chicago in 1982. He was general secretary of the National Conference of Catholic Bishops from 1968 to 1972 and conference president from 1974 to 1977. He became a spokesman for American bishops opposing the nuclear arms race and seeking greater economic justice in the United States.

Bernardin was born April 2, 1928, in Columbia, South Carolina. He was ordained a priest in 1952. He served in administrative positions in the diocese of Charleston, South Carolina, from 1952 until 1966, when he became an auxiliary bishop and was assigned to the archdiocese of Atlanta, Georgia. From 1972 to 1982, he served as archbishop of Cincinnati, Ohio. Robert P. Imbelli

Berners-Lee, Tim (1955-), a British computer scientist, developed the World Wide Web. The World Wide Web, or Web for short, is part of the Internet, the worldwide network of computers. The Web allows computer users to compose and view "pages" that may contain pictures, video, animation, and sound, in addition to text. See **Internet; World Wide Web.**

In 1980, while working at the European Organization for Nuclear Research (CERN) near Geneva, Switzerland, Berners-Lee devised a system that linked words in one computer file to those in another—a technique known as *hypertext.* About 1989, Berners-Lee conceived the World Wide Web, initially as a way for physicists around the world to link their own documents to CERN computer files. He wrote the Web software in 1990, and in 1991, the Web became part of the Internet. He created HTML (*H*yper*T*ext *M*arkup *L*anguage), a coding system that describes how Web pages should appear when viewed using computer programs called *Web browsers.* Berners-Lee also designed a uniform resource locator (URL), an addressing system that assigns each Web page a unique location. In addition, he devised HTTP (*H*yper*T*ext *T*ransfer *P*rotocol), a system for transferring documents between computers on the Web.

Berners-Lee was born June 8, 1955, in London. He earned a physics degree from Oxford University in 1976.

Paul N. Edwards

See also **Internet** (picture).

Bernese mountain dog, *bur NEEZ,* is a long-haired dog. It weighs from 50 to 75 pounds (23 to 34 kilograms), and measures from 21 to 27 inches (53 to 69 centimeters) tall at the shoulder. Bernese mountain dogs are jet black with white chests and feet, and have rich brown markings on their legs and face. They are hardy and faithful, and make excellent pets. Their ancestors were brought to Switzerland by invading Roman soldiers more than 2,000 years ago. Until about 1910, the dogs were almost unknown outside of Bern, Switzerland, where basket weavers used them to pull small wagons.

Critically reviewed by the American Kennel Club

See also **Dog** (picture: Working dogs).

Bernhardt, Sarah (1844-1923), a French actress, was one of the great international stage stars of her time. Bernhardt was celebrated for her graceful movements and the bell-like clarity and rich tones of her voice. She also won praise for the heightened emotional and physical realism of her acting.

Bernhardt was born on Oct. 23, 1844, in Paris. Her real name was Henriette-Rosine Bernard. She made her acting debut at the Comédie-Française in 1862 in the title role of Jean Racine's classic tragedy *Iphigénie.* Other notable roles in her long career included the title characters in Racine's *Phaedra,* Victorien Sardou's *Tosca,* and Eugene Scribe's *Adrienne Lecouvreur;* and Marguerite Gautier in Alexandre Dumas fils' *La Dame aux Camilias.*

In 1880, Bernhardt broke with the Comédie-Française and spent the rest of her career as a successful theater manager and independent touring star, usually leading

her own company. She performed only in French, but still toured the United States and Canada nine times between 1880 and 1918.

Bernhardt was an accomplished painter and sculptor. She also wrote poems and plays. She wrote two books, an autobiography, *Memories of My Life* (1907); and observations on acting and theater, *The Art of the Theater* (published in 1924, after her death). Daniel J. Watermeier

Bernier, *buhr nee AY,* **Joseph Elzéar,** *zhoh ZEHF ehl zay AIR* (1852-1934), was a Canadian explorer known for his voyages to the Arctic. During an expedition in 1908 and 1909, Bernier claimed all the islands in the North American region of the Arctic for Canada. This action asserted Canada's claim to the Arctic region and awakened the Canadian public to the importance of the far north. Bernier served as captain on 12 Arctic voyages and also made several journeys around the world.

From 1906 to 1909, Bernier made two voyages to a number of islands in the Arctic. During these journeys, he traveled through Lancaster Sound to the islands of Banks, Melville, and Victoria, and then to McClure Strait and Prince of Wales Strait. From 1910 to 1913, he led two expeditions in the Baffin Island area.

Bernier was born on Jan 1, 1852, in L'Islet, Quebec. His father and grandfather were sea captains. Bernier began to command ships at the age of 17. He described his voyages in *Master Mariner and Arctic Explorer* (1939). Barry M. Gough

Bernini, *buhr NEE nee,* **Gian Lorenzo** (1598-1680), an Italian sculptor, was probably the most famous artist of the 1600's. He was an outstanding interpreter of the *baroque,* a highly ornamental style. He also wrote comedies, painted portraits, and was an architect.

Bernini's intensely dramatic baroque style appears in many of his works, notably his sculptures for the Cornaro Chapel in Rome. The chapel altarpiece becomes a stage where an angel is poised to drive an arrow into the heart of a swooning Saint Teresa. Bernini also created realistic works, particularly portraits. His best-known architecture, the great plaza of St. Peter's Basilica, symbolizes the church's welcoming embrace. His bronze canopy with its twisted columns shelters the high altar. He was born in Naples on Dec. 15, 1598. Roger Ward

See also **Saint Peter's Basilica** (with picture); **Sculpture** (Sculpture from 1600 to 1900; picture).

Bernoulli's principle, *buhr NOO leez,* also called *Bernoulli's law* or *Bernoulli's theorem,* states that energy is conserved in a moving *fluid* (liquid or gas). If the fluid is moving in a horizontal direction, the pressure decreases as the speed of the fluid increases. If the speed decreases, the pressure increases. For example, water moves faster through a narrow portion of a horizontal pipe than through a wider portion. Bernoulli's principle predicts that the pressure will be lowest where the speed is greatest. Bernoulli's principle was named for Daniel Bernoulli, a Swiss mathematician of the 1700's.

Bernoulli's principle can explain how airplane wings create the upward force called *lift* and how a baseball pitcher can throw a curve ball. An airplane wing is shaped so the air speed above the wing is greater than the air speed below. This means the air pressure below the wing is greater than the pressure above, and the wing is pushed upward. In throwing a curve ball, a pitcher makes the ball spin fast. As a result, the air speed is greater on one side of the ball than on the other. The resulting difference in air pressure produces a net force toward the lower-pressure side and pushes the ball along a curved path. Richard A. Martin

See also **Aerodynamics; Hydraulics.**

Bernstein, *BURN styn,* **Leonard** (1918-1990), was an American conductor, composer, and pianist. Bernstein served as musical director of the New York Philharmonic Orchestra from 1958 to 1969, the first American to hold that position. During this period, the orchestra's prestige increased greatly. Bernstein often performed as solo pianist while conducting at the same time.

Bernstein probably became best known for his musicals, including *On the Town* (1944), *Wonderful Town* (1953), *Candide* (1956, revised 1973), and *West Side Story* (1957). His other compositions include the symphony *Jeremiah* (1944), the ballet *Fancy Free* (1944), the short opera *Trouble in Tahiti* (1952) and its sequel *A Quiet Place* (1983), and music for the film *On the Waterfront* (1954).

Bernstein composed *Mass* for the opening of the John F. Kennedy Center for the Performing Arts in Washington, D.C., in 1971. He also composed *Chichester Psalms* (1965), for chorus and orchestra; and *Songfest* (1977), for six vocal soloists and orchestra.

Bernstein also made many television appearances. He won fame for his ability to discuss music clearly and vividly so he could be understood by people with little musical knowledge. He adapted the texts from several of his TV shows into *The Joy of Music* (1959). Six lectures on music that he gave at Harvard University in 1973 were published as *The Unanswered Question* (1976).

Bernstein was born on Aug. 25, 1918, in Lawrence, Massachusetts. In 1943 and 1944, Bernstein was assistant conductor of the New York Philharmonic. He became famous in August 1943 when, on short notice, he conducted a Philharmonic concert that was broadcast nationally. Richard Jackson

Berry, as defined by botanists, is a fleshy, many-seeded fruit. A berry has its seeds imbedded within the flesh of a single, juicy, enlarged ovary (see **Flower** [Fertilization]). Blueberries, tomatoes, and grapes are berries. But strawberries, blackberries, and raspberries are not berries by the botanical definition (see **Fruit** [Simple fruits; illustration]). Most people call any small, fleshy fruit that contains many seeds a berry. Paul Eck

Related articles in *World Book.* All the fruits in the following list fit the botanical definition of berry.

Banana	Grape	Lingonberry	Pepper
Blueberry	Grapefruit	Muskmelon	Tangerine
Cranberry	Guava	Orange	Tomato
Currant	Huckleberry	Oregon grape	Watermelon
Gooseberry	Lime		

Berry, Chuck (1926-), is an American singer, composer, and guitarist. He became one of the earliest and most important performers of rock music.

Charles Edward Anderson Berry was born on Oct. 18, 1926, in St. Louis, Missouri, and started playing the guitar during his teens. His first hit record was "Maybellene" (1955). More hits followed during the next three years. Berry's popularity then declined until 1972, when "My Ding-a-Ling" became his biggest hit.

Many critics believe that Berry's lyrics about the social significance of rock music have made him an important folk poet. His song "Rock and Roll Music" (1957) is a trib-

ute to that musical form, and he expressed its value to youth in "Sweet Little Sixteen" (1958). His style has influenced many rock performers, including the Beatles and the Rolling Stones. *Chuck Berry: The Autobiography* was published in 1987.

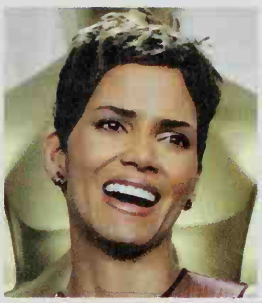
Don McLeese

National Broadcasting Company, Inc.

Chuck Berry

Berry, Halle, *HAL ee* (1968-), is an American motion-picture star known for her beauty and her versatile acting. Berry won the 2001 Academy Award as best actress for her performance as the wife of a man sentenced to die in the tense drama *Monster's Ball.* Berry was the first African American to win the Oscar as best actress.

Berry has appeared in a wide variety of films. They include the comedies *Boomerang* (1992), *The Flintstones* (1994), and *B.A.P.S.* (1997); the action movie *The Last Boy Scout* (1991); the drama *Losing Isaiah* (1995); the political satire *Bulworth* (1998); and the science fiction film *X-Men* (2000).



AP/Wide World

Halle Berry

Halle Maria Berry was born on Aug 14, 1968, in Cleveland. In 1985, she won the Miss Teen Ohio beauty pageant. The same year Berry was named Miss Teen All American. In 1986, she was runner up to Miss USA After working as a model, Berry got her first break in acting as a regular on the television comedy series "Living Dolls" in 1989. She also appeared in the hit TV dramatic series "Knots Landing" in 1991 and 1992. Berry made her film debut with an acclaimed performance as a crack addict in *Jungle Fever* (1991).

Louis Giannetti

Berry, Martha McChesney (1866-1942), was an American educator who established schools for poor Southern mountain people. In 1902, she opened a boys' boarding school in an old log cabin in Mount Berry, Georgia. She added a similar school for girls in 1909.

The Berry Schools stressed instruction in agricultural, vocational, and household skills. Berry's main goal was teaching people skills that would be useful in their own communities. She encouraged her students to return there after graduation. Berry developed a work-study program that enabled students to help pay for their education by doing part-time manual labor. This work was related to their course of study. Berry founded Berry College in 1926 in Mount Berry. Berry was born on Oct. 7, 1866, near Rome, Georgia.

Anne Firor Scott

Berryman, John (1914-1972), was an American poet and critic. He wrote about his experiences in a personal, sometimes obscure style. His most famous poem, *Homage to Mistress Bradstreet* (1950), re-creates the life of Anne Bradstreet, a colonial American poet. In this long narrative dialogue, Bradstreet and Berryman discuss both the colonial and the modern world.

Berryman won the Pulitzer Prize in 1965 for his autobiographical collection *77 Dream Songs* (1964). He wrote a continuation of this work called *His Toy, His Dream, His Rest* (1968). Both volumes reflect Berryman's vision of death as a welcome rest after the intense joy and pain of life. Much of this work deals with the impact of his father's suicide, which occurred when Berryman was 12 years old. Berryman's best-known work of literary criticism was *Stephen Crane* (1950), a critical biography of the American novelist and poet.

Berryman was born on Oct. 25, 1914, in McAlester, Oklahoma. He taught at the University of Minnesota from 1954 until his suicide at the age of 57. His *Collected Poems, 1937-1971* was published in 1989.

Paul B. Diehl

Bertillon system, *BUR tuh lahn,* is a method that was once widely used to identify people by their physical measurements. It was named after the French statistician Alphonse Bertillon and was first used in Paris in 1873. Bertillon had the French police measure parts of the body of every prisoner and make a record of the height, the length of arms and legs, and the length and width of the skull. These measurements, 11 in all, do not change greatly after a person has matured. Fingerprinting has mostly replaced the Bertillon system because it is more accurate.

John I. Thornton

Berton, Pierre (1920-), is a Canadian author and television personality. Berton's books and other works reflect his interest in a wide variety of subjects.

Berton was born on July 12, 1920, in Whitehorse in the Yukon Territory and graduated from the University of British Columbia in 1941. He worked for newspapers in Vancouver, British Columbia, and then for *Maclean's Magazine* from 1947 to 1959 and in 1962 and 1963.

Berton became widely known for a four-volume series of historical books on the opening of the Canadian Northwest. He began the series with *Klondike Fever* (1958), which describes the gold rush in the Yukon Territory during the late 1890's. He traced the construction of Canada's first transcontinental railroad in *The National Dream* (1970) and *The Last Spike* (1971). *The Promised Land* (1984) covered settlement from 1896 to 1914. Berton also wrote *Why We Act Like Canadians* (1982) and *The Klondike Quest: A Photographic Essay, 1897-1899* (1983). He also wrote children's books, a cookbook, and books about religious and social issues.

Berton's TV career began in 1946. He became a regular panelist on "Front Page Challenge," Canada's longest-running TV program, when it started in 1957. Berton also has hosted various radio programs.

T. D. Regehr

Beryl, *BEHR uhl,* is a hard mineral composed of beryllium, aluminum, silicon, and oxygen. Although pure beryl is colorless, most beryl crystals have impurities that give them various colorings of blue, green, red, and yellow. Emerald is a dark green beryl. Aquamarine is a pale blue or bluish-green beryl. People use beryl crystals mostly as gemstones. Beryl also is a source of the chemical element beryllium. Major uses of beryllium include parts for rockets and missiles, and windows in X-ray tubes.

The chemical formula of beryl is $Be_3Al_2Si_6O_{18}$. Most beryl crystals are *hexagonal* (six-sided). They can measure up to 18 feet (5.5 meters) long. The best emeralds come from Colombia. Gem quality beryl also occurs in

Brazil, Russia, South Africa, the United States, and Zimbabwe. Commercial laboratories produce gem quality beryl. Kenneth J. De Nault

See also **Aquamarine; Beryllium; Emerald; Gem.**

Beryllium, *buh RIHL ee uhm,* is a rare, light-gray metallic element. Beryllium never occurs in nature as a pure metal. But it is found in bertrandite, beryl, chrysoberyl, phenacite, and other minerals. Beryl and bertrandite are the most important sources of beryllium. The German chemist Friedrich Wöhler and the French chemist A. A. Bussy, working independently, isolated the first samples of pure beryllium in 1828.

Beryllium's atomic number is 4. Its atomic weight is 9.012182. Its chemical symbol is Be. Beryllium is a brittle, lightweight metal with one of the highest melting points of all light metals. It melts at temperatures from 1273 to 1283 °C and boils at 2970 °C. At 20 °C, it has a density of 1.848 grams per cubic centimeter (see **Density**).

X rays pass easily through pure beryllium. For this reason, the metal is used to make small windows in X-ray tubes. Beryllium's light weight and its capacity for absorbing and conducting heat make it useful for specialized parts in satellites, missiles, and rockets. An alloy of beryllium and copper is used to make electrical parts, such as electrically conducting springs. Beryllium oxide is a good heat conductor but a poor electrical insulator. It is used as a heat-conducting electrical insulator in electronic devices and lasers.

If beryllium dust is inhaled, it can cause *berylliosis,* a chronic lung disease that is sometimes fatal. Some scientists believe excessive exposure to beryllium may also produce lung cancer. Duward F. Shriver

See also **Beryl; Wöhler, Friedrich; X rays.**

Berzelius, *buhr ZEE lee uhs,* **Jöns Jakob** (1779-1848), a noted Swedish chemist, made valuable contributions to chemical analysis and atomic theory. He was one of the discoverers of the element cerium. Berzelius also discovered the elements selenium and thorium. He was the first to isolate the elements calcium, silicon, and tantalum. He developed the system of using letters of the alphabet for chemical symbols and formulas, and urged classification of minerals according to chemical composition. Berzelius was born in Götland. See also **Cerium; Chemistry** (Dalton's atomic theory); **Element, Chemical** (table); **Selenium; Thorium.** Melvyn C. Usselman

Besant, *BEHZ uhnt,* **Annie Wood** (1847-1933), was a British social reformer and a leader of a philosophical movement called *theosophy.* She also was a prominent figure in India's struggle for independence from Britain.

Besant lectured widely on a number of social issues, including planned parenthood and labor reform. In 1888, she helped organize a strike at a London match factory, one of the first successful strikes by unskilled workers. At that time, Besant was a member of the Fabian Society, an organization of British socialists.

In 1889, Besant joined the Theosophical Society, which combined the teachings of various religions, especially Hinduism and Buddhism, and studied the psychic powers of human beings. Besant served as president of the society from 1907 until her death in 1933.

In 1894, Besant moved to India, where she continued her work in theosophy and began supporting Indian educational reform. In 1898, she opened the Central Hindu College (now Banaras Hindu University) at Banaras (now Varanasi), India. In the early 1900's, she became involved in the independence movement and, in 1916, founded the Indian Home Rule League. From 1918 to 1920, she served as president of the Indian National Congress, the leading independence group.

Annie Wood was born in London. She married Frank Besant, an English clergyman, in 1867. Chris Cook

Bessarabia, *BEHS uh RAY bee uh,* is a historical region in eastern Europe. It covers 17,147 square miles (44,411 square kilometers), and lies in parts of Moldova and Ukraine. Bessarabia is bordered by the Dnestr River on the north and east, the Black Sea and Danube River on the south, and the Prut River on the west.

Most of Bessarabia's people are Moldovan, Ukrainian, Russian, or Bulgarian farmers. They raise grapes and other fruits, grain, beets, and tobacco. Canning is the chief industry.

Russia gained Bessarabia from the Turks in 1812. Southern Bessarabia was awarded to the historical principality of Moldavia in 1856, at the end of the Crimean War. Russia regained Southern Bessarabia in 1878. After World War I (1914-1918), Romania controlled Bessarabia until 1940, when the Soviet Union seized the region during World War II. Romania reoccupied Bessarabia in 1941, but the Soviet Union regained it in 1944. Bessarabia then became part of the Moldavian and Ukrainian republics of the Soviet Union. The Moldavian Republic became the Moldovan Republic in 1990. In 1991, the Soviet Union was dissolved, and Moldova and Ukraine became independent countries. Theodore Shabad

Bessborough, *BEHZ bruh,* **Earl of** (1880-1956), served as governor general of Canada from 1931 to 1935. He was the first governor general appointed solely on the advice of the Canadian government. Before 1931, the British government had played the major role in selecting the governor general.

Bessborough was born in London. His given and family name was Vere Brabazon Ponsonby. He served in the British Parliament in 1910 and from 1913 to 1920. He assumed the title of earl in 1920. While Bessborough was governor general, he revived the Dominion Drama Festival, a series of amateur drama competitions. Canada was formally recognized as independent from the United Kingdom during his term, in 1931. Jacques Monet

Bessel, *BEHS uhl,* **Friedrich Wilhelm** (1784-1846), was a German astronomer and mathematician. He studied a class of mathematical functions now called "Bessel functions," which are extensively used in physics today. In 1838, Bessel published the first authentic measurement of a star's *annual parallax,* an apparent change in the star's position. Annual parallax is a result of the earth's motion around the sun. Bessel was born at Minden. Michael J. Crowe

Bessemer, *BEHS uh muhr,* **Sir Henry** (1813-1898), a British engineer, devised the Bessemer process for converting pig iron into steel. In this process, air is blown through the molten pig iron, burning out most of its impurities. Bessemer patented his process in 1855, and the British iron industry eagerly adopted it. The process made steel inexpensive to produce, and its use spread throughout the world. Although the process remained in use until after World War II (1939-1945), the open-hearth method had become more important by 1910.

Bessemer was born in Hertfordshire. As a young man,

he worked with metals, inventing processes for electroplating objects with copper and for making gold and bronze powder. He also invented a typesetting machine. Bessemer was one of the most honored engineers of his time. He was knighted in 1879. Bruce E. Seely

See also **Iron and steel** (The birth of modern steelmaking).

Best, Charles Herbert (1899-1978), a Canadian physiologist, was a principal discoverer of the hormone insulin. During 1921, Best and colleagues at the University of Toronto—particularly Frederick G. Banting, John J. R. Macleod, and James B. Collip—isolated and prepared insulin for the treatment of diabetes (see **Banting, Sir Frederick Grant; Insulin**). Best was a 22-year-old medical student at the time of the discovery. He became director of the University of Toronto physiology department in 1929. In 1941, he became director of the Banting and Best Department of Medical Research. Best was born in West Pembroke, Maine. Audrey B. Davis

Beta-blocker is a type of drug that plays a major role in treating heart disorders. Beta-blockers reduce the rate and force of the heartbeat, lower blood pressure, and lessen the workload of the heart. For these reasons, doctors often prescribe beta-blockers to control high blood pressure and reduce the risk of second heart attacks in some patients. Beta-blockers also help control abnormal heart rhythms and prevent repeated attacks of *angina pectoris,* chest pains due to an inadequate oxygen supply to the heart muscle. Beta-blockers also are prescribed to prevent migraine headaches and to control *glaucoma,* an eye disease.

Beta-blockers include the drugs propranolol, nadolol, and metoprolol. They work by blocking reception of impulses from the *sympathetic nervous system.* Stimulation by the sympathetic nervous system prepares the heart and many other body organs for increased activity or for emergency situations. The organs receive impulses from the sympathetic nervous system at special sites called *alpha* and *beta receptors.* Beta-blockers interfere with reception at the beta receptor sites.

Beta-blockers may produce insomnia and fatigue, and can trigger heart failure in persons with weak hearts. The drugs also can cause problems for people with asthma and for diabetics who use antidiabetes drugs. Henry R. Besch, Jr.

Beta particle, *BAY tuh,* is an electron given off by the nucleus of a radioactive atom when it undergoes a nuclear transformation. Most beta particles are negatively charged and are formed when a neutron converts to a proton. Some beta particles are *positrons* (positively charged electrons) produced by the transformation of a proton. A beta particle is very tiny. It has only about $\frac{1}{1,840}$ the mass of a proton (see **Proton**). Its high energy enables it to travel far in air and to pass through solid matter several millimeters thick. Scientists gauge a beta particle's energy by measuring how far it can penetrate certain substances. John W. Poston, Sr.

See also **Radiation; Transmutation of elements.**

Beta Persei. See **Algol.**

Betatron. See **Particle accelerator.**

Betel, *BEE tuhl,* is a preparation made from a palm tree and a vine plant grown in Asia. People in southern Asia, Indonesia, the Philippines, and eastern Africa chew the *betel nut* (seed of the palm tree) with the leaf of the vine plant. The nut is prepared for chewing by boiling and drying. It is sometimes prepared raw by drying, smoking, or salting. The pieces are rolled in a leaf of betel vine smeared with quicklime. Betel colors saliva red and blackens teeth that are neglected. James D. Mauseth

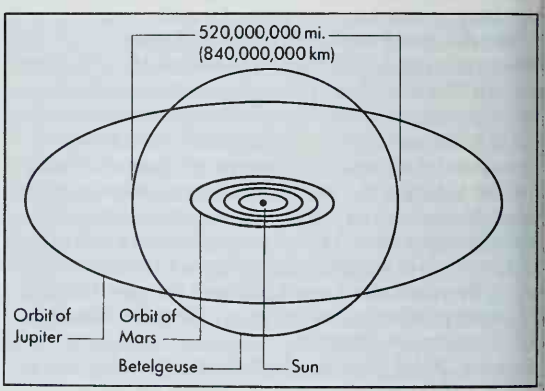
Scientific classification. The betel palm is in the palm family Arecaceae or Palmae. Its scientific name is *Areca cathecu.* The betel vine is in the pepper family, Piperaceae, and is *Piper betle.*

Betelgeuse, *BEE tuhl jooz,* also called *Alpha Orionis,* is one of the brightest stars in the constellation of Orion. Betelgeuse is called an *irregular variable* because it changes in brightness and size but has no regular periods of variation. In its normal range of brightness, it is a star of the first *magnitude.* The brighter a star is, the lower is its magnitude (see **Magnitude**).

Astronomers classify Betelgeuse as a *red supergiant.* The star has a deep red color because its surface temperature is low for a star—only half that of the sun. However, the maximum diameter of Betelgeuse is about 600 times as large as the diameter of the sun.

Betelgeuse is about 500 light-years from the earth. One light-year equals about 5.88 trillion miles (9.46 trillion kilometers). In 1996, the Hubble Space Telescope photographed the surface of Betelgeuse, the first photo taken of the surface of a star other than the sun. The image shows a large spot on the surface of Betelgeuse that is over 3,600 Fahrenheit degees (2,000 Celsius degrees) hotter than the surrounding matter. Sumner Starrfield

See also **Astronomy** (map: The stars and constellations of the Northern Hemisphere); **Orion.**



WORLD BOOK diagram

Betelgeuse has a maximum diameter about 600 times the diameter of the sun. If Betelgeuse were placed in the center of the solar system, it would cover the orbit of Mars.

Bethlehem (pop. 16,313) is the birthplace of Jesus Christ. It lies about 5 miles (8 kilometers) south of Jerusalem in a region of the Middle East called the West Bank (see **West Bank** [map]).

In Hebrew, *bethlehem* means *house of bread.* The Arabic name is *Bayta lahm,* which means *house of meat.* Bethlehem is chiefly a religious shrine. It has many houses of worship and other religious institutions.

Bethlehem was a walled city during the time of King David, who was born there. Greeks, Romans, and Arab Muslims ruled it at various times. Christian crusaders captured it during the First Crusade (1096-1099), but they later lost it to the Ottomans, Muslims from central

E. Streichan, Shostal

Bethlehem lies south of Jerusalem in the Judean Hills. The city has many historic houses of worship.

Asia. The Ottoman Empire gained control in the 1500's. In 1917, during World War I, British forces led by General Edmund Henry Hynman Allenby took the town. It became part of Jordan in 1950, when the country annexed the West Bank. Israel took control of the West Bank, including Bethlehem, during the Six-Day War of 1967. In 1995, Israel withdrew from Bethlehem and gave control to Palestinian Arabs. Bernard Reich

See also **Allenby, Lord; Crusades; Jesus Christ.**

Bethlehem Steel Corporation is the second largest steel company in the United States. Only United States Steel Corporation is larger. Bethlehem Steel has six plants that manufacture a wide range of steel products, including bars, beams, pipe, plates, rails, rods, and wire. These plants are in Bethlehem, Johnstown, and Steelton, Pennsylvania; Burns Harbor, Indiana; Lackawanna, New York; and Sparrows Point, Maryland. The company also has facilities that make railroad cars and such industrial forgings as turbines for electric generators.

The corporation owns coal mines in Pennsylvania and West Virginia. It partly owns iron mines in Minnesota, Canada, and Brazil. A facility in Maryland repairs and services ships and makes industrial products.

The corporation was established in 1904. Charles M. Schwab, a former president of United States Steel, helped organize Bethlehem Steel and served as its first president. Eugene G. Grace, who started at Bethlehem as a crane operator, succeeded him as president in 1916. Grace became chairman in 1945 and headed the firm until his death in 1960. Under his leadership, Bethlehem developed into one of the world's largest steel companies. Its headquarters are in Bethlehem.

Critically reviewed by Bethlehem Steel Corporation

Bethune, *buh THOON,* **Mary McLeod** (1875-1955), was an African American educator. She was a forceful, inspiring leader who worked to improve educational opportunities for blacks. She also fought for the rights of African American women. In 1904, she opened a school for black girls in Daytona Beach, Florida. It became a coeducational college in 1923 and is now called Bethune-Cookman College. Bethune served as its president until 1942.

Presidents Calvin Coolidge, Herbert Hoover, Franklin D. Roosevelt, and Harry S. Truman appointed Bethune to various government posts. From 1935 to 1944, she was Roosevelt's special adviser on minority affairs. Bethune also served, from 1936 to 1944, as director of the Division of Negro Affairs of the National Youth Administration (NYA). She was the first black woman to head a federal agency. Bethune helped persuade the NYA to adopt nondiscrimination policies and to create a fund to aid black graduate students and black colleges.

United Press Int.

Mary Bethune

Bethune was born on July 10, 1875, in Mayesville, South Carolina. Her parents were former slaves. She attended a mission school, a seminary, and the Moody Bible Institute. She was president of the National Association of Colored Women (now the National Association of Colored Women's Clubs) from 1924 to 1928. In 1935, she received the Spingarn Medal (see **Spingarn Medal**). That same year, she founded the National Council of Negro Women. Gerald L. Gutek

Additional resources

McLoone, Margo. *Mary McLeod Bethune.* Bridgeston, 1997. Younger readers.

McCluskey, Audrey T., and Smith, E. M., eds. *Mary McLeod Bethune.* 1999. Reprint. Ind. Univ. Pr., 2001.

Bethune, *buh THOON,* **Norman** (1890-1939), a Canadian surgeon, became a national hero of China because of his medical service there. He went to China in 1938, when China was at war with Japan. Bethune organized hospitals in the field, served as a battlefield surgeon, and set up medical schools. In 1938, he became medical chief of the Chinese Eighth Route Army.

Henry Norman Bethune was born on March 3, 1890, in Gravenhurst, Ontario, and began his medical career in 1917. He was stricken by tuberculosis in 1926 and spent about a year recovering. From 1928 to 1936, Bethune practiced medicine in Montreal. He won worldwide fame for experiments in lung surgery and for the invention of instruments used in chest surgery.

In 1936, Bethune joined the Republican forces fighting in the Spanish Civil War. That same year, he developed the first mobile blood transfusion service in history. Bethune served in China for about 21 months and died there of blood poisoning. Roderick J. Stewart

Betjeman, *BEHCH uh muhn,* **John** (1906-1984), was probably the best-selling English poet of the 1900's. In 1972, Queen Elizabeth II appointed him poet laureate of the United Kingdom. His works are neither light verse nor completely serious poetry. Betjeman's best-known poems poke gentle fun at the English, as in "In Westminster Abbey":

> Think of what our Nation stands for,
> Books from Boots' and country lanes,
> Free speech, free passes, class distinction,
> Democracy and proper drains.

From *Collected Poems* by John Betjeman, courtesy Houghton Mifflin Co. and John Murray, Ltd.

Occasionally, when dealing with religion or death, Betjeman was more serious and sympathetic.

Betjeman was born in London. His collected poems

were published in 1958. *Summoned By Bells* (1960) is his verse autobiography. An expert on architecture, he wrote widely on that subject. Betjeman was knighted in 1969. William Harmon

Betta. See Fightingfish.

Bettelheim, *BEHT tehl hym,* **Bruno** (1903-1990), became famous during his life for his work with emotionally disturbed children. From 1944 to 1973, he served as director of the University of Chicago's Sonia Shankman Orthogenic School for severely troubled children. He also taught psychology and psychiatry at the university.

Bettelheim was born and educated in Vienna, Austria. In 1938, he was one of many Jews imprisoned in Nazi concentration camps. He was released in 1939 and came to the United States. In 1944, he became a U.S. citizen.

After his death, biographers discovered that Bettelheim had exaggerated some of his achievements. For example, he received only one of several advanced degrees he claimed to have earned at the University of Vienna. He also made a false claim that he had studied with the famous psychoanalyst Sigmund Freud. Bettelheim often described the atmosphere that he created at the Orthogenic School as gentle and healing. But former patients and co-workers said that he abused some children with spankings and other harsh treatment.

Analysis of Bettelheim's books shows that he apparently copied extensively from the work of others. Even *The Uses of Enchantment: The Meaning and Importance of Fairy Tales,* which won a National Book Award in 1977, appears based on borrowed ideas.

Paul R. McHugh

Better business bureau is a nonprofit corporation organized by businesses to protect the public from unfair advertising and business practices. More than 200 cities in the United States and Canada have better business bureaus. There are also bureaus in Israel and Puerto Rico.

Many consumers contact better business bureaus to ask about the reliability of a company before making a purchase or investment. Others register complaints with a bureau about business practices they consider unfair. The bureau then attempts to resolve the dispute through mediation or arbitration. If a bureau cannot convince a business to adopt fair practices, it may refer the case to a government agency.

The Council of Better Business Bureaus serves as headquarters of the better business bureau system. The council is located in Arlington, Virginia.

Critically reviewed by the Council of Better Business Bureaus

Beverly Hills (pop. 33,784) is a city in southern California that is famous as the home of many movie stars and other wealthy people. It is largely surrounded by Los Angeles. For location, see **California** (political map).

Most of the people of Beverly Hills live in spacious, expensive houses or apartments. The city also has luxury hotels and large department stores. Its Rodeo Drive is a famous shopping street. Tourists from many parts of the world visit Beverly Hills to shop and to see celebrities' houses. Many doctors, lawyers, and business people have offices in Beverly Hills. During the daytime, about 200,000 people come to Beverly Hills to work or shop. A city law designed to avoid urban overcrowding prohibits buildings more than four stories high. Beverly Hills was founded on ranch land in 1914 and quickly became a place of luxury. It has a council-manager form of government. Kenneth Reich

See also **California** (picture: Beverly Hills).

Bevilacqua, *BEHV uh LAHK kwuh,* **Anthony Joseph Cardinal** (1923-), was appointed a cardinal of the Roman Catholic Church by Pope John Paul II in 1991. The pope had named Bevilacqua archbishop of Philadelphia in 1988.

Bevilacqua was born in Brooklyn, a borough of New York City. He was ordained a priest in 1949. Between 1968 and 1980, Bevilacqua taught canon law at the Seminary of the Immaculate Conception in Huntington, New York. He was assistant chancellor, vice chancellor, and chancellor of the diocese of Brooklyn between 1965 and 1980. In 1980, he was ordained auxiliary bishop of Brooklyn. From 1983 to 1988, he was bishop of the diocese of Pittsburgh, Pennsylvania. Robert P. Imbelli

Bewick, *BYOO ihk,* **Thomas** (1753-1828), was the most important wood engraver in English art. He became known for his book illustrations of animals and country life. Most of Bewick's illustrations are small, measuring only about 4 inches (10 centimeters) wide. They show his sense of humor, love of landscape, and understanding of people. Bewick engraved hundreds of animal illustrations for *A General History of Quadrupeds* (1790). He used both live animals and stuffed animals as models. He copied other artists' illustrations for pictures of animals he had never seen, such as lions and bison. He also illustrated the two-volume work *A History of British Birds* (1797, 1804). Bewick was born in Cherryburn, near Newcastle upon Tyne. Elizabeth Broun

Bhagavad-Gita, *BUHG uh vuhd GEE tah,* is one of the most widely read and beloved of Hindu scriptures. The title means *Song of the Lord* in Sanskrit, an ancient Indian language. The Bhagavad-Gita forms only a small portion of a long epic called the *Mahabharata,* but its importance is enormous, especially in modern Hinduism.

The *Bhagavad-Gita* sets forth the god Krishna's teachings to the warrior hero Arjuna. It is presented as a conversation between Arjuna and Krishna, who appears in human form as Arjuna's friend and chariot driver. The conversation occurs on a battlefield at the beginning of a war between Arjuna and members of his family. Arjuna faces a difficult choice. As a warrior, he must defend his brother, the king. However, he has cousins, other relatives, and teachers on the opposing side. Arjuna wonders how to act in such a dilemma. Krishna teaches him that people can achieve freedom by following their prescribed duty without attachment to the results of their action.

The *Bhagavad-Gita* also portrays Krishna as a god whose greatness takes in everything in the universe. This concept of Krishna is conveyed in a vision described in the text. Krishna rises above any particular form and yet is present for believers as a close friend with whom they can have a loving relationship.

David L. Haberman

See also **Krishna; Mahabharata; Vishnu.**

Bhutan, *boo TAHN,* is a small, developing independent country in south-central Asia. It lies in the eastern Himalaya between India and Tibet.

Bhutan is a rugged, mountainous country with great extremes in climate. Thick forests grow on the rain-drenched southern slopes of the mountains. It is ex-

tremely hot in the low foothill regions and extremely cold in the Great Himalaya. Only in the mid-Himalaya regions is the climate moderate. Almost all Bhutanese are hardy mountaineers who farm and raise stock. They live in isolated valleys, cut off from one another by mountains. Bhutan had little contact with the rest of the world until the late 1950's. Thimphu, a town of about 40,000, is the capital of the country.

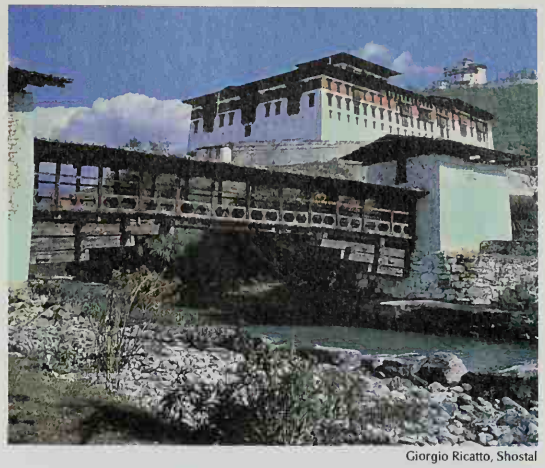
Government of Bhutan is a *hereditary* (inherited) monarchy headed by a powerful king. The king appoints one-fourth of the 150-member *Tsongdu* (national assembly). Village headmen elect about three-fourths of the Tsongdu members. The remaining Tsongdu members represent powerful Buddhist monasteries. The Tsongdu elects a Cabinet of Ministers. Both Tsongdu members and Cabinet ministers serve five-year terms. The chief duty of both bodies is to advise the king.

A *dzongtap* (district officer) is responsible for law and order in each of Bhutan's 18 administrative divisions. Families in each village elect a headman to a three-year term. Bhutan has no legal political parties.

People. Bhutan's two largest ethnic groups, the Sharchops and the Ngalops, make up more than half of the population. The Ngalops are descendants of Tibetan settlers. The Sharchops' origin is uncertain, but they may have come from Tibet long ago. The two groups are sometimes known together as the Bhotes or Bhutias. About a fourth of Bhutan's people are Nepalese. Several languages are spoken in Bhutan. Dzongkha, a Tibetan dialect, is the official language.

The Sharchops and the Ngalops practice Buddhism, Bhutan's official religion. About 4,500 *lamas* (monks) in Bhutan belong to the Red Hat Order of Lamas. They perform Buddhist rituals, treat illnesses, and teach sacred doctrine. They live in fortified monasteries called *dzongs,* which have chapels, offices, and teaching centers. Most of Bhutan's Nepalese practice Hinduism.

WORLD BOOK maps



Giorgio Ricatto, Shostal

A Bhutanese *dzong* (fortified monastery) dominates the Paro Valley. Dzongs are centers of art, religion, and culture in Bhutan.

Bhutan's Hindus live in compact villages along the Indian border. They build rectangular houses of mud blocks and stones. They build on high ground for protection against floods, wild animals, and snakes. People in the small villages of the mid-Himalaya valleys live in houses of oblong stone blocks that have pine-shingle roofs. The family lives upstairs and uses the ground floor as a barn. In the high, northern mountain valleys, people live in small villages surrounded by stone walls. People of Tibetan descent wear a long, loose coat made from a colored blanket. This style of coat is gathered around the waist and hangs to the knees.

Most of Bhutan's people 15 years old and older cannot read and write. For the country's literacy rate, see **Literacy** (table: Literacy rates).

Land. Bhutan has three major land regions. A region of plains and river valleys lies along the Indian border in the south. It ranges from about 150 to 3,000 feet (46 to 910 meters) above sea level. Bananas, citrus fruits, and rice are grown in its hot, humid climate.

Mountains in the mid-Himalayan region, which is north of the plains, rise to from 5,000 to 14,000 feet (1,500 to 4,270 meters) above sea level. Ash, oak, poplar,

Facts in brief

Capital: Thimphu.
Official language: Dzongkha, a Tibetan dialect.
Form of government: Monarchy.
Area: 18,147 mi² (47,000 km²). *Greatest distances*—north-south, 110 mi (177 km); east-west, 200 mi (322 km).
Elevation: *Highest*—Kula Kangri, 24,783 ft (7,554 m) above sea level. *Lowest*—150 ft (46 m) above sea level in the south.
Population: *Estimated 2002 population*—2,238,000; density, 123 per mi² (48 per km²); distribution, 85 percent rural, 15 percent urban. *1969 census*—1,034,774.
Chief products: *Agriculture*—barley, fruit, rice, vegetables, wheat. *Handicrafts and industries*—blankets, leatherwork, pottery, preserved fruit, textiles. *Mining*—coal.
Flag: The square flag is divided diagonally into yellow and orange halves. A white dragon in the center has a jewel in each claw. See **Flag** (picture: Flags of Asia and the Pacific).
Money: *Basic unit*—ngultrum. One hundred chetrums equal one ngultrum.

and willow trees grow in this region's moderate climate. Mountains in the Great Himalaya, the northernmost region, rise over 24,000 feet (7,320 meters). The climate above 14,000 feet (4,270 meters) is very cold. Snow and glaciers cover parts of this region all year. Rivers run from north to south, forming fertile valleys.

Economy. Most Bhutanese are farmers and herders. Most farmers plant crops in fertile valleys or in irrigated terraces on mountain slopes. Barley, rice, and wheat are the chief crops. People in the high mountain areas herd cattle and yaks. Coal is produced in the south. Bhutan trades chiefly with India. It exports electric power and timber, and imports gasoline, grain, and kerosene

Until 1960, Bhutan lacked communications, power, and trained workers. Since then, with Indian aid, Bhutan established orchards, stock-breeding farms, a distillery, and a fruit-preserving factory. India also helped Bhutan build roads and train farmers. The Bhutan government makes money by selling collectors' postage stamps.

History. Little is known of Bhutan's early history. In the 800's, Tibetan invaders conquered the Bhutia Tephoo—the country's original inhabitants—and settled Bhutan. By the early 1500's, descendants of the Tibetan invaders controlled Bhutan from a number of large dzongs located in the mid-Himalayan region. In the early 1600's, Bhutan became a separate state when a Tibetan lama took power as ruler of both religious and state affairs. In 1907, Ugyen Wangchuck, a powerful *penlop* (territorial lord), was chosen to administer the government. He made himself Bhutan's first king and gave the country its first effective central government.

In the 1700's and 1800's, the Bhutanese raided Sikkim and part of what was then British India. These raids caused the United Kingdom to take control of some of Bhutan's foreign affairs. In 1910, the British Indian government took full control of Bhutanese foreign relations, but the British did not interfere with Bhutan's internal government. In 1949, India agreed to handle Bhutan's foreign affairs and to help develop its economy. India later assumed responsibility for the defense of Bhutan.

Bhutan remained isolated from the rest of the world until 1959, when China claimed part of the country. Bhutan then strengthened its ties to India and began to modernize its economy, educational system, and health facilities. In 1972, King Jigme Dorji Wangchuck died and was succeeded by his son, Jigme Singye Wangchuck. In the early 1990's, antigovernment protests by people of Nepalese descent turned violent. Many Nepalese fled to refugee camps in Nepal. James F. Fisher

See also Asia (picture: Whirling Bhutanese dancers); Lamaism; Sikkim; Thimphu.

Bhutto, *BOO toh,* Benazir, *BEHN uh zihr* (1953-), served as prime minister of Pakistan from 1988 until 1990 and from 1993 to 1996. She was the first woman ever to head an elected government in an Islamic nation.

Benazir Bhutto was born in Karachi. She attended Harvard University in the United States and Oxford University in the United Kingdom. Her father, Zulfikar Ali Bhutto, founded the Pakistan People's Party (PPP) and became prime minister in 1971. In 1977, he was overthrown by General Mohammed Zia-ul-Haq and imprisoned. The military government executed him in 1979. Benazir Bhutto was also arrested and imprisoned several times. In 1984, she went into exile in the United Kingdom. She returned to Pakistan in 1986, after the military relaxed some restrictions, to head the PPP.

© D. Aubert, Sygma

Benazir Bhutto

Zia died in 1988. Elections in December 1988 brought the PPP to power, and Bhutto became prime minister. In 1990, Pakistan's president charged her government with corruption. He removed Bhutto from office. In 1993, elections returned the PPP to power, and she became prime minister again. In 1996, Pakistan's president charged her government with corruption and again removed her from office. In 1999, she was convicted of corruption, sentenced to five years in jail, barred from public office, and fined. She fled to the United Kingdom and appealed the conviction. In 2001, Pakistan's Supreme Court ordered a retrial. Robert LaPorte, Jr.

Biafra. See Nigeria (Civil war).

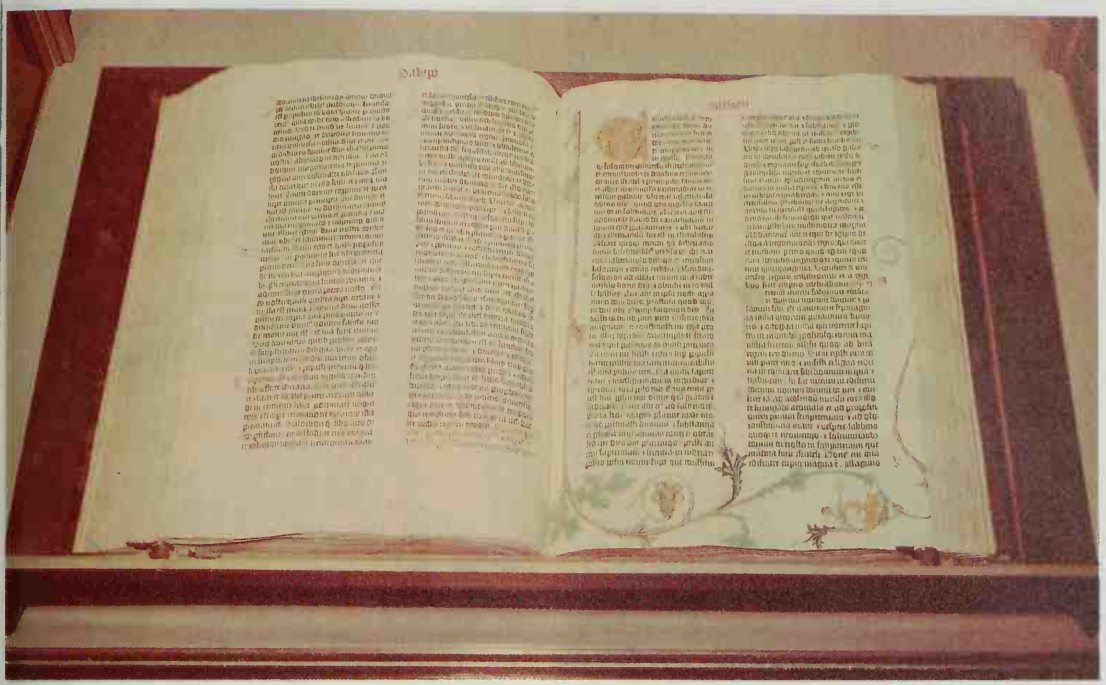
Bialik, *BYAH lihk,* Chaim Nachman (1873-1934), is considered the greatest poet in modern Hebrew literature. He was a leader in a Jewish nationalist movement that revived interest in Hebrew language and literature.

One of Bialik's most famous poems is "In the City of Slaughter" (1904). Bialik wrote this and other "poems of wrath" in response to *pogroms* (massacres) and persecution of Jews in Russia and other eastern European countries. In these poems, he criticized Jewish tolerance of injustice and cried out for resistance. His poems inspired the organization of Jewish self-defense groups. "The Talmud Student" (1894-1895) reflects his admiration for Jews who dedicate their lives to the study of holy writings. He believed that such dedication had enabled Judaism to survive. In *The Dead of the Desert* (1902), Bialik urged a cultural reawakening of the Jewish people.

Bialik also wrote short stories and essays. He founded a Hebrew publishing house, translated classics into Hebrew, and edited books of medieval Hebrew poetry.

Bialik was born in Ukraine. His name is also spelled Hayyim Nahman Bialik. He settled in Tel Aviv, Palestine (now Israel), in 1924. Stanley L. Nash

Biathlon, *by ATH lahn,* is a winter sport that combines cross-country ski racing and rifle marksmanship. Competitors, while carrying a rifle on their back, ski over a course consisting of loops of various lengths. The loops return to a 50-meter shooting range. There, competitors fire at five targets, first from the *prone* (lying down) position and, after skiing another loop, from the standing position. Biathlon events include individual, sprint, pursuit, and relay races. The individual or team to complete the course in the fastest time wins. In individual events, the course is 20 kilometers (12.4 miles) for men and 15 kilometers (9.32 miles) for women. The sprint distances are 7.5 kilometers (4.66 miles) for women and 10 kilometers (6.2 miles) for men. The pursuit distances are 10 kilometers for women and 12.5 kilometers (7.77 miles) for men. Four people each ski 7.5 kilometers in a relay. Extra time or distance is added as a penalty for missed targets. See also Olympic Games (table); Skiing (Nordic competitions). Critically reviewed by the U.S. Biathlon Association



Rare Book Collection, Yale University (John C. Trever)

The Gutenberg Bible was the first Bible printed from movable type. It was produced in the workshop of Johannes Gutenberg in Mainz, Germany, during the mid-1400's. The Gutenberg Bible was an edition of the *Vulgate*, a Latin translation completed by Saint Jerome in A.D. 405.

Bible

Bible is the name given to several collections of writings held sacred by the Jewish and Christian religions. It is also known as the Holy Scriptures. Both religions regard the Bible as inspired by God. They base many of their beliefs and customs on the teachings found in the Bible. The Bible is the most widely distributed book in history. It has also been translated more times, and into more languages, than any other book.

The Jewish and Christian Bibles differ from each other in several ways. The Jewish Bible is commonly called the Hebrew Bible because most of it was written in Hebrew. It tells the story of Creation. It also contains information on pre-Israelite times and the history and religious life of ancient Israel from about 1300 B.C. to the 100's B.C. The Hebrew Bible, which Christians call the Old Testament, forms the first part of the Christian Bible. The second part of the Christian Bible, the New Testament, was written in Greek. It covers about 100 years, from the birth of Jesus Christ to about A.D. 125. Some Christian groups also include in the Old Testament additional originally Jewish writings that are not found in the Hebrew Bible. The individual writings collected in the Bible are known as *books*. The books that are officially accepted by any group as part of its Bible are called the *canon*.

Both the Jewish and the Christian Bibles view God as the supreme power behind the events they describe, though God's role may not always be apparent. The Bible does not define God or try to prove God's existence. Instead, it testifies to God's presence in history including, in the Christian Bible, the life of Jesus Christ and the development of the early church.

Scholars value the books of the Bible not only as important religious writings but also as great literary works. The Bible includes many forms of literature, such as letters, stories, history, laws, prophecies, prayers, songs, love poems, and epics. Its vivid, realistic tales of the struggles, failures, and triumphs of both great and ordinary people entertain as well as teach. Literary critics have praised its beautiful poetry and stirring calls to faith.

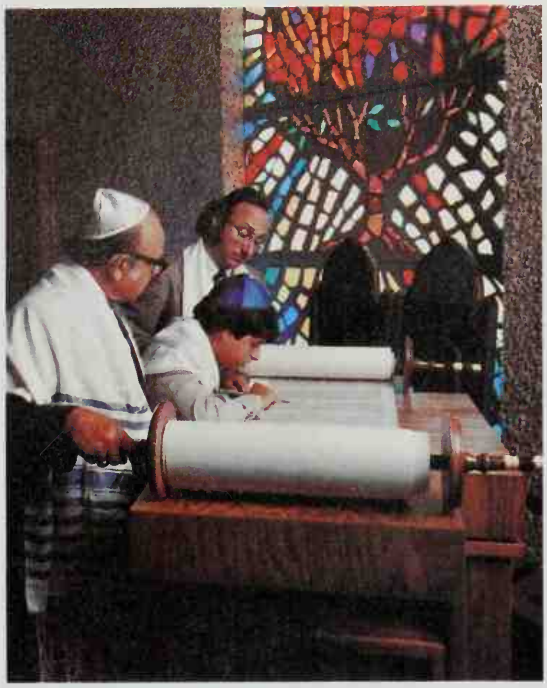
Readers have long differed over how to explain the meaning of the Bible. Some people believe that every event mentioned in the Bible actually happened exactly as the Bible says it did. Others feel that many events in the Bible must be read as symbols of religious belief.

This article presents a broad survey of the Bible. Many *World Book* articles provide detailed information on various aspects of the Bible. A list of articles appears at the end of this article.

The Hebrew Bible

Almost all of the Hebrew Bible was written in Hebrew. A few parts, especially sections of the Book of Daniel and the Book of Ezra, were written in another ancient language called Aramaic.

Books of the Hebrew Bible. The Hebrew Bible consists of 24 books. The Christian Old Testament divides some of the books, increasing their number to 39. In addition, Roman Catholic Bibles add seven books to the Old Testament. These books first appeared in a Jewish



WORLD BOOK photos by Ed Hoppe

The religious life of Jews and Christians is strongly based on the Bible. At the left, a Jewish boy reads from the Torah, the first five books of the Old Testament, during Sabbath services. At the right, a study group sponsored by a Christian church discusses the New Testament.

translation of the Bible into Greek during the mid-200's B.C. The canon of the Greek Orthodox Church is the same as that of the Catholic Church, with five additional books. They are 1 and 2 Esdras, Prayer of Manasseh, Psalm 151, and 3 Maccabees.

The books of the Hebrew Bible are organized into three sections—the Law (Pentateuch), the Prophets, and the Writings. The name by which Jews know the Hebrew Bible, *Tanakh,* is formed from the first letter of the Hebrew word for each section: *Torah, Nebiim,* and *Ketubim.* The Christian Old Testament is divided into four sections—Pentateuch, Historical Books, Wisdom Books, and Prophets. For a list of all the books found in the Hebrew Bible and the Roman Catholic and Protestant canons, see the table in this article. The following discussion describes the three sections of the Hebrew Bible.

The Law consists of five books. It is also called *Pentateuch,* from two Greek words meaning *five books,* and *Torah.* The Book of Genesis describes God's creation of the world, early human history, and the origin of the Israelites. The other books trace the early history of the Israelites, ancestors of the Jews. They begin with Exodus, containing the departure of the Israelites from Egypt under their leader Moses, and they end with the death of Moses at the entrance to Canaan (what is now Israel). These books also contain the Ten Commandments and many of the laws that serve as the basis of Judaism today.

The Law was the first part of the Bible to be accepted into the canon. A group of Jews called Samaritans still accept only this part of the Bible (see **Samaritans**).

The Prophets were teachers and thinkers who played a major role in the political and religious life of the Israelites. This section of the Hebrew Bible was the second to be accepted into the canon. It is divided into the Former Prophets and the Latter Prophets. The division is based on the order of the books in the Bible and not on the order in which they were written.

The Former Prophets consist of four books—Joshua, Judges, Samuel, and Kings. These books continue the history of the Israelites from the settlement of Canaan to the capture of Jerusalem by the Babylonians in 587 or 586 B.C. The authors of the Former Prophets drew from historical sources for their discussions of prophets, judges, and kings. But their chief purpose was to demonstrate the power of God and the divine role in history.

The Latter Prophets also consist of four books. Three books relate teachings associated with prophets named Isaiah, Jeremiah, and Ezekiel. The fourth book gathers the teachings of 12 other prophets. The Book of Isaiah may include the teachings of more than one prophet. One prophet named Isaiah probably lived in the 700's B.C. Another prophet, also known as Isaiah, probably lived about 200 years later. In general, the earlier prophets, such as Jeremiah and the first Isaiah, called on the people to repent from their sins and renew their faith in God. The later prophets, including Ezekiel and the second Isaiah, taught after the exile of the Jews to Babylonia in 586 B.C. They spoke of their hope for God's forgiveness and a return to their land.

The Writings consist of 11 books of various kinds. The Book of Psalms is made up of religious poetry. The Books of Ruth, Esther, and Daniel are stories drawn from Jewish history. The Song of Songs (also called the

The books of the Bible

The tables below give the titles of the books of the Old Testament and the New Testament. The three lists of Old Testament books show the names and order of books as accepted by Jews, Protestants, and Roman Catholics. Protestants and Roman Catholics accept the same names and the same order of books in the New Testament.

The Hebrew Bible/Old Testament

Jewish version

The Law
- Genesis
- Exodus
- Leviticus
- Numbers
- Deuteronomy

The Prophets
- Joshua
- Judges
- Samuel
- Kings
- Isaiah
- Jeremiah
- Ezekiel
- The Twelve*

The Writings
- Psalms
- Proverbs
- Job
- Song of Songs
- Ruth
- Lamentations
- Ecclesiastes
- Esther
- Daniel
- Ezra-Nehemiah
- Chronicles

Protestant version (King James Bible)

Pentateuch
- Genesis
- Exodus
- Leviticus
- Numbers
- Deuteronomy

Historical books
- Joshua
- Judges
- Ruth
- 1 Samuel
- 2 Samuel
- 1 Kings
- 2 Kings
- 1 Chronicles
- 2 Chronicles
- Ezra
- Nehemiah
- Esther

Wisdom books
- Job
- Psalms
- Proverbs
- Ecclesiastes
- Song of Solomon

Prophets
- Isaiah
- Jeremiah
- Lamentations
- Ezekiel
- Daniel
- Hosea
- Joel
- Amos
- Obadiah
- Jonah
- Micah
- Nahum
- Habakkuk
- Zephaniah
- Haggai
- Zechariah
- Malachi

Roman Catholic version (New American Bible)

Pentateuch
- Genesis
- Exodus
- Leviticus
- Numbers
- Deuteronomy

Historical books
- Joshua
- Judges
- Ruth
- 1 Samuel
- 2 Samuel
- 1 Kings
- 2 Kings
- 1 Chronicles
- 2 Chronicles
- Ezra
- Nehemiah
- Tobit
- Judith
- Esther
- 1 Maccabees
- 2 Maccabees

Wisdom books
- Job
- Psalms
- Proverbs
- Ecclesiastes
- Song of Songs
- Wisdom
- Sirach (Ecclesiasticus)

Prophets
- Isaiah
- Jeremiah
- Lamentations
- Baruch
- Ezekiel
- Daniel
- Hosea
- Joel
- Amos
- Obadiah
- Jonah
- Micah
- Nahum
- Habakkuk
- Zephaniah
- Haggai
- Zechariah
- Malachi

The New Testament

Gospels
- Matthew
- Mark
- Luke
- John

Acts of the Apostles

Letters
- Romans
- 1 Corinthians
- 2 Corinthians
- Galatians
- Ephesians
- Philippians
- Colossians
- 1 Thessalonians
- 2 Thessalonians
- 1 Timothy
- 2 Timothy
- Titus
- Philemon
- Hebrews
- James
- 1 Peter
- 2 Peter
- 1 John
- 2 John
- 3 John
- Jude

Revelation

*Hosea, Joel, Amos, Obadiah, Jonah, Micah, Nahum, Habakkuk, Zephaniah, Haggai, Zechariah, Malachi

Song of Solomon) is a collection of love poems. Lamentations consists of five poems that mourn the destruction of Jerusalem by the Babylonians. Other books include history (Ezra, Nehemiah, and Chronicles) and *wisdom literature,* or philosophical writings (Proverbs, Job, and Ecclesiastes). Of these books, Job concerns the unknowable nature of God. Ecclesiastes is a largely pessimistic discussion of the nature of life.

Development of the Hebrew Bible. Scholars have evidence of many similarities between ancient Hebrew literary and legal traditions and those of other Near Eastern cultures, including Mesopotamian law codes, Egyptian wisdom literature, and Canaanite poetry. But no written sources tell how the Hebrew Bible began to develop. Clues to its early development must be taken almost entirely from the Bible itself.

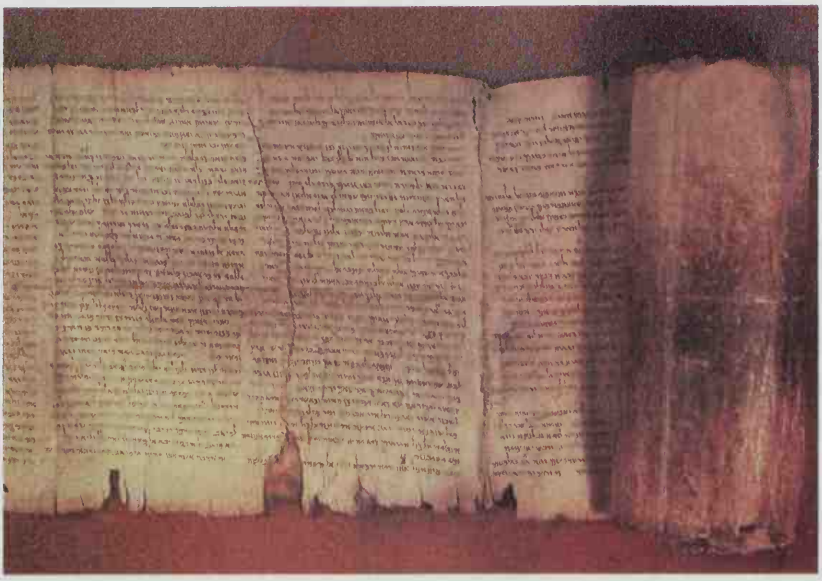
Jewish writers have discussed the origins of the Law since pre-Christian times. According to Jewish and Christian tradition, these books are "the books of Moses." But the books themselves do not say Moses was the author. Some scholars believe the Law began as oral literature and was written down following the reign of King David—that is, after about 1000 B.C.

In analyzing the books of the Law, Biblical scholars have noted differences in vocabulary, style, the names for God, and the idea of God. They have also noted duplications of stories. Many scholars believe this evidence shows that several persons or groups wrote the Law. They suggest that four documents originally existed. These documents were written over at least 500 years and were combined by a number of editors.

The books of the Prophets may reflect the way the

Fresco (about A.D. 300's) by an unknown artist in the Catacomb of San Callisto, Rome (Hirmer Verlag)

Scenes from Biblical stories decorate the walls of burial places used by early Christians in Rome. This painting shows Moses striking a rock to get water in the desert.



School of Theology at Claremont (John C. Trever)

The Dead Sea Scrolls are the oldest known manuscripts of any books of the Bible. Some of the scrolls may be more than 2,000 years old. They were discovered in the mid-1900's in caves near the northwestern shore of the Dead Sea in Southwest Asia. The scroll at the left shows part of the Old Testament Book of Isaiah.

prophets' words were remembered and honored long after their deaths. The words of later generations are partly mixed with those of the prophets, either as an explanation or as actual changes in what the prophets said. Only by careful study can modern readers try to separate the original messages of the prophets from later revisions.

The authors of the Writings are unknown, though several are associated with various ancient leaders. Many of the Psalms begin with a one-line heading or introduction. The headings in about one-half of the Psalms contain David's name and some people take these references as indications of authorship. Other individuals are also mentioned in these headings, and may have been authors of some Psalms. The Book of Psalms, which actually consists of at least five ancient books, is best understood as a collection of anthologies of psalms written by many people. David's son Solomon is said to have written the Song of Songs. These traditions may have arisen because verses in the books can be understood as "Psalm of David" or "Song of Solomon." In fact, the Hebrew word used in these verses may mean *of, to,* or *for.*

Development of the Christian Old Testament. Jews living in Palestine used the Bible in its original Hebrew version. But many Jews living outside of Palestine spoke other languages. During the mid-200's B.C., Jewish scholars in Egypt translated the Bible into Greek. For more information on this translation, see the section on *The first translations* in this article.

Other books were added to the Hebrew Bible in its Greek translation. Some of these books were translations of Hebrew works. Others were original compositions in Greek. In addition, the Greek translation expanded the books of Esther and Daniel.

When Christianity began to spread throughout the Greek-speaking world about the A.D. 50's, Christians used the Greek translation of the Bible. This translation became the Christian Old Testament.

During the A.D. 1500's, some Protestant scholars became concerned that the Old Testament contained books not found in the Hebrew Bible. The scholars removed these books from the Old Testament and called them *Apocrypha.* For this reason, the Protestant Old Testament includes only those writings that form the Hebrew Bible. Some Protestant editions of the Bible include the Apocrypha as a separate section. The word *apocrypha* comes from a Greek word meaning *hidden.* Scholars disagree on why the word was applied to these writings.

The list below gives the titles and order of the books in the Revised Standard Version of the Apocrypha.

1 Esdras
2 Esdras
Tobit
Judith
Additions to the Book of Esther
Wisdom of Solomon
Ecclesiasticus, or the Wisdom of Jesus the Son of Sirach
Baruch
Letter of Jeremiah
Prayer of Azariah and the Song of the Three Young Men
Susanna (Additions to Daniel)
Bel and the Dragon
Prayer of Manasseh
1 Maccabees
2 Maccabees

The Roman Catholic Old Testament includes all of these books except 1 and 2 Esdras and the Prayer of Manasseh. The Letter of Jeremiah, Prayer of Azaria, and Bel and the Dragon occur as additions to Old Testament books. The Greek Orthodox Old Testament includes all of the books on this list.

The New Testament

The New Testament records the life of Jesus Christ. It also deals with the development of the early church and the meaning of faith in Jesus. The New Testament was written in Greek, which was widely spoken during the time of Jesus. Jesus and His disciples spoke Aramaic.

Books of the New Testament. The New Testament consists of 27 books organized into four sections—the Gospels, the Acts of the Apostles, the Letters, and Reve-

lation. The number of books and their order are the same in the Roman Catholic and Protestant versions. For the complete canon, see the table in this article.

The Gospels consist of four books—Matthew, Mark, Luke, and John. They appear as the first books in the New Testament, though they are not the earliest works in the canon. The word *gospel* comes from the Old English word *godspell,* which means *good news.*

The Gospels themselves do not mention their authors' names. However, the early church attributed them to two of Christ's apostles, Matthew and John, and two companions of apostles, Mark and Luke. Today, many scholars doubt that these men were the actual authors of the gospels.

All four Gospels describe the life of Jesus. Matthew, Mark, and Luke have similarities of detail and arrangement. They are called the *Synoptic Gospels.* The word *synoptic* comes from a Greek word that means *see together.*

The Synoptic Gospels differ from the Gospel of John in several ways. In the Synoptic Gospels, for example, Jesus expresses His teachings chiefly in short sayings and in brief stories called *parables.* In John, He teaches through long statements.

Although the Synoptic Gospels generally deal with the same events, each of the four Gospels regards Jesus differently. Matthew describes Him as the lawgiver who tells how Christians and their church should act. Mark shows Him as the Savior who triumphs through suffering. Luke presents Jesus as the Savior of all people. John concentrates on Jesus' divine nature.

Many scholars believe that Mark was the earliest Gospel. It was probably written just before or after the Roman army captured Jerusalem in A.D. 70. Matthew and Luke were written a little later. The contents of these two Gospels indicate that both authors knew Mark's Gospel but not each other's. John was written last, perhaps in the A.D. 90's. Each Gospel was probably first used in only one geographic area.

The Acts of the Apostles continues the story told in Luke and was written by the same author. Acts tells about the expansion of the early church. The story opens in Jerusalem, where the apostles gather after Jesus is raised from the dead. The book ends in Rome, where Saint Paul, the church's first great missionary, preaches to the Jews while a Roman prisoner.

The Ascension (about A.D. 586), a water color on parchment by Rabula, a Syrian priest; Laurentian Library, Florence, Italy (G. B. Pineider)

Illuminations were pictures and designs that decorated many hand-copied Bibles during the Middle Ages. This scene of Jesus Christ rising to heaven appears in a copy of the Gospels.

The Letters make up 21 books. These books contain some of the earliest writings in the New Testament, though they appear in the canon after the Gospels and the Acts. The Letters are also known as *Epistles,* from a Greek word meaning *letter.* The first 13 letters are called the *Pauline letters.* They claim to be letters from Saint Paul mainly to Christian congregations he had founded.

By permission of the John Rylands Library, Manchester, England

An ancient fragment of the Gospel of John dates from the early A.D. 100's, making it the oldest known example from any New Testament book. The two sides of the fragment, *left,* were part of a papyrus manuscript written in Greek.

Ben Asher Codex (about A.D. 900); The British Library Board, London (John C. Trever)

The Masoretic text is the standard Jewish version of the Old Testament. It was prepared by Jewish scholars, called *Masoretes,* mainly from the A.D. 500's to the 900's. The Masoretes studied each letter, word, and phrase of the Old Testament in the original Hebrew language. They wrote marginal notes on the Biblical texts, commenting on proper grammar and spelling.

The last eight letters are called *General Letters.* Most of them claim to be letters from early church leaders.

Most scholars doubt that Paul actually wrote all 13 of the Pauline Letters. The letters he did write provide a record of Paul's preaching. The letters discuss problems of faith and conduct. Most of them were probably written in the A.D. 50's and early 60's.

The General Letters were written over a number of years to about A.D. 125. They deal with problems faced by second- and third-generation Christians. In form, the General Letters resemble the Pauline Letters.

Revelation is also called the *Apocalypse,* from a Greek word meaning *revelation.* A man named John wrote the book, but he is probably not the same person who wrote the Gospel of John.

Revelation begins as a letter "to the seven churches that are in Asia." It then gives a symbolic description of God's final triumph, through Christ, over evil and death. This description comes from a series of visions of the future sent by God to the author through an angel.

Development of the New Testament. The first generation of Christians preserved memories of Jesus Christ's teachings, deeds, and Crucifixion largely by word of mouth. The story of Jesus was not written down in the Gospels until the second generation of the church.

The authors of the New Testament did not deliberately try to create a Christian Bible. The early church had a Bible, the Hebrew Bible, especially in its Greek translation. But, differing views of Christian faith in the A.D. 100's led the church to form the New Testament canon. It needed the canon as authority against unacceptable religious views. The church also wanted to preserve the authentic story of Jesus' life and death in writing for future generations of Christians.

The church asked three main questions about the writings it considered for the canon. (1) Were the writings widely accepted and used in the church? (2) Did they follow the church's traditional teachings? (3) Were they thought to have been written or authorized by an apostle?

By about A.D. 200, the church canon included most of today's New Testament. In A.D. 367, the content of the New Testament was first listed exactly as we now know it. This canon was gradually adopted by all Christians.

The Bible as history

Historical study of the Bible has two main aspects. One aspect concerns the historical accuracy of events mentioned in the Bible. The second concerns how scholars can use the Bible to learn more about the history and people of the ancient Near East.

Historical accuracy of the Bible. Scholars have been able to confirm many of the statements of the Bible through archaeology and the study of documents written by other peoples of the ancient Near East. For example, scholars have discovered the decree of Cyrus, king of Persia, permitting the peoples exiled by his Babylonian predecessors to return to their ancestral lands and to reclaim their sacred shrines and holy objects. For this reason, the Biblical story of Cyrus' permitting the Jews to return to Israel with the utensils from the Jerusalem Temple and to rebuild the Temple may be taken as historically verified.

It is impossible to confirm the miraculous events described in the Bible. People may explain them in several ways. Some people regard miraculous occurrences, such as the appearance of angels, as dreams or prophetic visions. Others seek scientific explanations for Biblical miracles. They suggest that the story of Joshua's making the sun stand still in the sky represents a solar eclipse, or that Jesus and Elisha brought seemingly dead children back to life using mouth-to-mouth resuscitation. But such theories can never be proved, and they do not explain all Biblical miracles.

Many scholars and religious authorities believe that some Biblical stories originated in the desire of ancient Hebrew leaders to disprove certain ancient Near Eastern beliefs. Scholars have found such meanings in a number of Biblical stories, including the Creation, the Flood, and the Ten Plagues.

The Bible as a historical source. The authors of the Bible did not intend only to record the facts of history. They interpreted the facts and events to teach their philosophy of history and their beliefs about God and God's role in history. However, the Bible is the best source

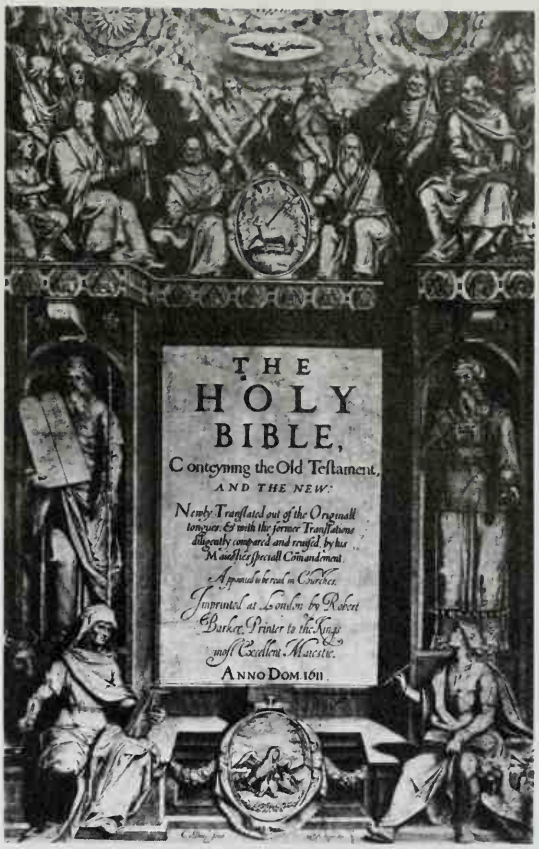
of information about many historical periods and events. In other cases, the Bible can add to what is already known from other sources. Whichever the case, it is the job of the historian to separate the facts of history from the Bible's interpretation of it. The historian must reconstruct this history using facts from the Bible and those obtained from non-Biblical sources.

An example of the Bible's treatment of history appears in the story of the Israelites' escape from Egypt and their journey to the land of Canaan. The Book of Exodus tells how God parted the waters of the Red Sea, leaving a dry path for the Israelites to walk across. God then closed the waters and drowned the pursuing Egyptians. The book goes on to describe the route the Israelites took in their journey to Canaan, and the battles and adventures they had along the way. Unfortunately, many of the locations mentioned are unknown today.

Some historians deny that the Israelites were ever in Egypt. Others argue that, because the Exodus is the most popular theme in the Hebrew Bible, it is impossible for it not to be true. There is a wide range of other opinion about the event. Some writers have sought scientific explanations for the crossing of the Red Sea, such as shifts in tides or storms. Others have interpreted the story of the crossing as a myth.

Translations of the Bible

The first translations of the Bible were oral versions of the Hebrew Bible in Aramaic. An Aramaic translation is called a *Targum,* which comes from a Hebrew word meaning *translation.* Targums were made for ancient Jewish communities that spoke Aramaic rather than Hebrew. Jews who spoke only Aramaic could not understand the Bible when it was read aloud in Hebrew. A translator would stand beside the reader in a synagogue and translate Hebrew passages into the local Aramaic language. Rabbinic tradition suggests that the practice of translating the Torah into Aramaic originated with the prophet Ezra when the Jews returned from Babylonia in the 400's B.C.

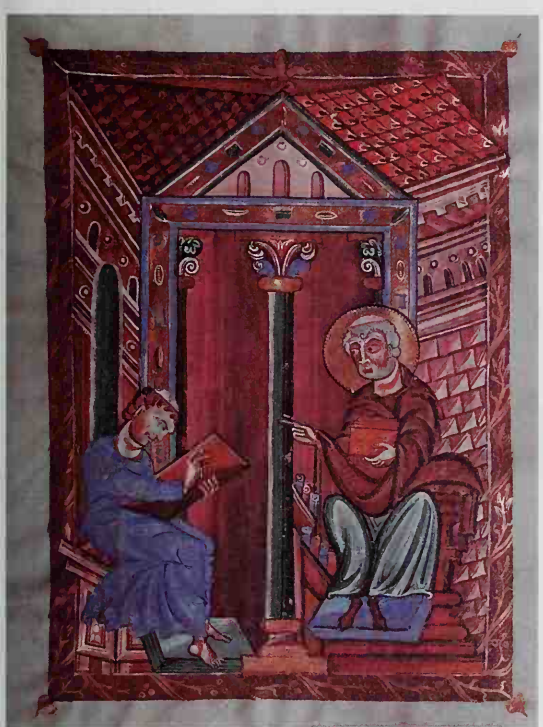


Title page of the 1611 edition; Beinecke Rare Book and Manuscript Library, Yale University

The King James Version of the Bible was printed in 1611. It served as the official translation for most English-speaking Protestants until the 1900's, when several new translations appeared.

Jews who lived in Greek-speaking parts of the world also needed a translation of the Bible. In the mid-200's B.C., a group of scholars working in Alexandria, Egypt, translated the Law into Greek. According to tradition, Ptolemy, the Greek king of Egypt, called 70 or 72 Jewish scholars to Alexandria to translate the Law for his famous library. The story tells that the scholars, working separately, all arrived at the same translation. The translation is called the *Septuagint,* from a Latin word meaning *seventy.* Later Greek translations of the rest of the Bible came to be considered part of the Septuagint.

Most of the first Christians spoke Greek, and so the early church used the Septuagint. But the need for more translations arose as Christianity spread to Syria and to



Miniature painting (1125 to 1150) from the *Cologne Gospels* by an unknown German artist; State Library, Bamberg, Germany

Saint Jerome, *right,* a great Biblical scholar of the early church, dictates to a scribe. Jerome's Vulgate was the only version of the Bible authorized by the Roman Catholic Church for centuries.

Latin-speaking countries. Bibles translated into Syriac (an Aramaic dialect) and Latin appeared in the A.D. 100's.

About A.D. 383, Saint Jerome began a revision of the Latin Bible at the request of Pope Saint Damasus I. As his sources for the Old Testament, Jerome used Hebrew and Greek texts and Latin translations. For the New Testament, he used Greek texts and Latin translations. He completed the project in A.D. 405. His version became known as the *Vulgate,* from the Latin word meaning *popular.* For centuries, it was the only version of the Bible authorized by the Roman Catholic Church.

Early English translations. The first complete English translation of the Bible appeared in the 1380's. The translation was made by John Wycliffe, an English priest, and his followers.

The German Protestant reformer Martin Luther translated the New Testament into German in 1522. He and his colleagues finished translating the rest of the Bible in 1534. About the same time, William Tyndale, an Englishman, translated the Bible into English while living in Germany. Tyndale based some of his translation on Luther's German version. Publication of Tyndale's New Testament began in Cologne, Germany, in 1525. Portions of the Old Testament appeared in 1530 and 1531. The vigorous language of Tyndale's translation greatly influenced most later translations and revisions of the Bible in English.

Miles Coverdale, an English bishop, prepared the first complete English Bible to be printed. He used much of Tyndale's translation, portions of Luther's Bible, and the *Vulgate.* Coverdale's Bible was printed in Germany in 1535.

English refugees living in France made the first Roman Catholic translation of the Bible from Latin into English. The New Testament was published in Reims (also spelled *Rheims*), France, in 1582. The Old Testament was published in Douay, France, in 1609 and 1610. The translation became known as the *Douay-Rheims Bible* or the *Douay Bible.*

The King James Version. In 1604, King James I of England authorized a committee of about 50 scholars to prepare a revision of earlier English translations of the Bible. The new version appeared in 1611 and became known as the *King James,* or *Authorized, Version.* The beauty and grace of the translation established the King James Version as one of the great treasures of the English language. No important English translations of the Bible appeared for more than 200 years after the publication of the King James Version. During this time, the *King James Version* was the most widely used translation in the English-speaking world.

By the mid-1800's, scholars and religious leaders were calling for fresh translations of the Bible. Scholars had more accurate knowledge of the original Hebrew and Greek Biblical texts and so uncovered many errors in the texts used by the *King James* revisers. Scholars also gained more knowledge of other ancient Near Eastern languages, which added to their understanding of the Biblical languages. In addition, the English language itself had changed greatly over the years. Many words in the *King James Version* no longer had the same meaning or were even understood by readers of the Bible.

In 1870, the Church of England decided to revise the *King James Version.* The New Testament appeared in 1881, the Old Testament in 1885, and the Apocrypha in 1895. But the early popularity of the translation, called the *Revised Version,* did not last. Most individuals and churches still preferred the *King James Version.*

Modern English translations. Several modern English translations of the Bible have tried to replace the out-of-date language of older versions. They have attempted to reproduce the flavor of everyday speech. These translations also have made improvements in printing the text of the Bible. For example, paragraphs separate the text into logical divisions, dialogue is enclosed in quotation marks, and poetry is printed to show its verse form.

In the early 1900's, James Moffatt, a Scottish scholar, translated the Bible in a rather free style. His New Testament appeared in 1913, and his Old Testament in 1924. In the United States, Edgar Goodspeed published a translation of the New Testament in 1923, and four other scholars published a version of the Old Testament in 1927. Their translations appeared in 1931 under the title *The Bible: An American Translation.*

The National Council of Churches of Christ in the U.S.A. sponsored a translation called the *Revised Standard Version,* which became highly popular. The New Testament was published in 1946, the Old Testament in 1952, and the Apocrypha in 1957. Several British Protes-

American Bible Society

New translations of the Bible reflect advances in Biblical scholarship during the 1900's. This committee of Protestant and Catholic scholars uses the results of modern Biblical research in translating the Old Testament from Hebrew into Portuguese.

tant churches sponsored a translation called the *New English Bible* (New Testament,1961; Old Testament and the Apocrypha, 1970). American Protestant scholars prepared the *New American Standard Bible* (New Testament , 1963; both Testaments, 1971). The American Bible Society sponsored a version commonly known as the *Good News Bible* (New Testament, 1966; Old Testament, 1976). Kenneth N. Taylor, an American author, completed *The Living Bible Paraphrased* in 1971. Taylor based his version on the *American Standard Version*, a 1901 revision of the *King James Version*. The New York Bible Society sponsored the *New International Version* (New Testament, 1973; Old Testament, 1976). A revised and updated version of *The Living Bible* was published in 1996 as the *New Living Translation*.

Roman Catholic scholars in England produced the *Jerusalem Bible* in 1966. They based their translation on a French version published in 1956. The first completely American Roman Catholic translation of the Bible was published in 1970 as the *New American Bible*.

Before the mid-1800's, English-speaking Jews used either the original Hebrew text or the *King James Version* of the Old Testament. Then, during the last half of the 1800's, Jewish scholars in Britain made several translations of the Hebrew Bible into English. But their translations were largely revisions of the *King James Version*. In 1917, a new translation of the Hebrew Bible into English was published in the United States. The Jewish Publication Society of America and the Central Conference of American Rabbis sponsored the project. The Jewish Publication Society also sponsored a new translation of the Hebrew Bible. Publication began in 1962 and was completed in 1981. This translation is noteworthy for its commitment to following the Hebrew Bible.

In 1973, a new edition of the *Revised Standard Version* appeared as the *Common Bible*. This edition was the first English translation of the Bible to be approved by Protestant, Roman Catholic, and Greek Orthodox religious leaders. In 1990, leaders of the major Christian faiths endorsed another new edition called the *New Revised Standard Version*. This edition, sponsored by the National Council of Churches, replaced many masculine words with words applying to both sexes.

For examples of how different translations treat a passage in the Bible, see the article **Lord's Prayer**.

The Bible in worship

Jews and Christians use the Bible in private and public worship. In public worship, Jews and many Christian groups read parts of the Bible according to an official schedule. The reading is often accompanied by teaching or preaching of an important lesson taken from it. In early Christian times, there were two systems of Torah reading in synagogues on the Sabbath. In Babylonia, Jews read the entire Torah every year. In Palestine, the reading took from 3 to 3 $\frac{1}{2}$ years. Eventually the Babylonian system became the accepted one. During the Middle Ages, the holiday of Simhat Torah was established to celebrate the conclusion of the annual reading cycle. But some parts of the Bible are never read as part of a public reading cycle. These parts include Job, Proverbs, Daniel, and Chronicles.

In some Protestant churches, the minister often selects the Biblical readings, which may be related to the topic of the sermon. Readings from the Bible are also included in morning and evening prayer services of the Church of England and other Anglican churches.

In the Roman Catholic Church, Bible passages are read during Mass. A series of daily prayers called the *divine office* consists almost entirely of Bible passages. In addition, parts of the Bible are read during such ceremonies as baptism, marriage, and funerals.

The Book of Psalms has an important role in Jewish and Christian worship. Many psalms have been set to music and sung as hymns. Congregations and choirs often sing these psalms at the beginning of and during services.

Terrance D. Callan and B. Barry Levy

Related articles in *World Book* include:

The Hebrew Bible

Books and prophets

Amos, Book of
Chronicles, Books of
Daniel, Book of
Deuteronomy
Ecclesiastes
Elijah
Elisha
Esther, Book of
Exodus
Ezekiel, Book of
Ezra, Book of
Genesis
Habakkuk, Book of
Haggai, Book of
Hosea, Book of
Isaiah, Book of
Jeremiah, Book of
Job, Book of
Joel, Book of
Jonah, Book of
Joshua
Judges, Book of
Kings, Books of
Lamentations
Leviticus
Malachi, Book of
Micah, Book of
Nahum, Book of
Nehemiah, Book of
Numbers, Book of
Obadiah, Book of
Pentateuch
Proverbs, Book of
Psalms, Book of
Ruth, Book of
Samuel, Books of
Song of Solomon
Zechariah, Book of
Zephaniah, Book of

Peoples and tribes

Amalekites
Assyria
Babylonia
Canaanites
Chaldea
Hittites
Jews
Levites
Philistines
Samaritans
Semites

Other men and women

Aaron
Abel
Abraham
Adam and Eve
Bathsheba
Benjamin
Cain
David
Deborah
Delilah
Esau
Gideon
Goliath
Hezekiah
Isaac
Ishmael
Jacob
Joseph
Josiah
Judah
Judah Maccabee
Judith
Lot
Methuselah
Moses
Noah
Rachel
Samson
Saul
Sennacherib
Solomon

The New Testament

See the article **Jesus Christ**. See also the following articles:

Books

Acts of the Apostles
Colossians, Epistle to the
Corinthians, Epistles to the
Ephesians, Epistle to the
Galatians, Epistle to the
Gospels (Matthew, Mark, Luke, John)
Hebrews, Epistle to the
James, Epistle of
John, Epistles of
Jude, Epistle of
Peter, Epistles of
Philemon, Epistle to
Philippians, Epistle to the
Revelation, Book of
Romans, Epistle to the
Thessalonians, Epistles to the

The Apostles

Andrew, Saint
Bartholomew, Saint
James the Greater, Saint
James the Less, Saint
John, Saint
Judas Iscariot
Jude, Saint
Matthew, Saint
Matthias, Saint
Peter, Saint
Philip of Bethsaida, Saint
Simon, Saint
Thomas, Saint

Other men and women

Barabbas
Barnabas
Gamaliel
Herod
James, Saint
John the Baptist, Saint

Joseph
Joseph of Arimathea
Lazarus
Luke, Saint
Magi
Mark, Saint
Mary
Mary Magdalene
Paul, Saint
Philip the Evangelist
Pilate, Pontius
Salome
Stephen, Saint
Timothy
Titus

Biblical places

Ararat
Babylon
Bethlehem
Calvary
Cities of refuge
Corinth
Damascus
Dead Sea
Eden
Edom
Egypt, Ancient
Ephesus
Galatia
Galilee
Galilee, Sea of
Gethsemane
Israel
Jerusalem
Jordan River
Judea
Mount of Olives
Mount Pisgah
Mount Sinai
Nazareth
Nineveh
Palestine
Patmos
Red Sea
Samaria
Sodom and Gomorrah
Syria
Tarsus
Ur
Zion

Translations and translators

James (I)
Jerome, Saint
Septuagint
Tyndale, William
Vulgate
Wycliffe, John

Other related articles

Altar
Allegory
Angel
Antichrist
Apostles
Aramaic language
Ark
Ark of the Covenant
Armageddon
Baal
Beatitudes
Beelzebub
Book
Creationism
Cross
Dead Sea Scrolls
Deluge
Devil
Eliot, John
Elohim
Epistle
Evolution (Acceptance of evolution)
Four Horsemen of the Apocalypse
Fundamentalism
Gideons International
God
Golden Rule
Gutenberg, Johannes
Handwriting on the wall
Hell
High priest
Jehovah
Lucifer
Manna
Messiah
Millennium
Miracle
New Testament
Old Testament
Parable
Paradise
Patriarch
Pharisees
Prophet
Sanhedrin
Scapegoat
Scribe
Simhat Torah
Tabernacle
Talmud
Ten Commandments
Tower of Babel

Outline

I. **The Hebrew Bible**
   A. Books of the Hebrew Bible
   B. Development of the Hebrew Bible
   C. Development of the Christian Old Testament
II. **The New Testament**
   A. Books of the New Testament
   B. Development of the New Testament
III. **The Bible as history**
   A. Historical accuracy of the Bible
   B. The Bible as a historical source
IV. **Translations of the Bible**
   A. The first translations
   B. Early English translations
   C. The King James Version
   D. Modern English translations
V. **The Bible in worship**

Questions

What produced the Vulgate translation of the Bible?
What was the original language of the Hebrew Bible? Of the New Testament?
How did the *Septuagint* get its name?
What are some ways in which the Bible is used in public worship services?
Why are the New Testament books of Matthew, Mark, and Luke called the *Synoptic Gospels*?
What is meant by the *canon*?
How many books are in the Hebrew Bible? In the New Testament?
What is the purpose of a *Targum*?
What are the Dead Sea Scrolls?
What are *illuminations*?
Who translated the King James Version of the Bible?
In what way have readers long differed in how to explain the meaning of parts of the Bible?

Additional resources

Level I

Alexander, Pat, and others, eds. *The Lion Encyclopedia of the Bible.* 2nd ed. 1986. Reprint. B M H Bks., 1987.
Day, Malcolm. *The Ancient World of the Bible.* Viking, 1994.
Lucas, Daryl J. *The Baker Bible Dictionary for Kids.* Baker Bk. Hse., 1997.
Pilling, Ann. *The Kingfisher Children's Bible.* Kingfisher Bks., 1993.
Pipe, Rhona. *The Big Book of Bible Facts.* Thomas Nelson, 1993.
Schmidt, Gary D. *The Blessing of the Lord: Stories from the Old and New Testaments.* Eerdmans, 1997.
Tubb, Jonathan N. *Bible Lands.* Knopf, 1991.

Level II

Aaseng, Rolf E. *A Beginner's Guide to Studying the Bible.* Augsburg, 1991.
Achtemeier, Paul J., ed. *The HarperCollins Bible Dictionary.* Rev. ed. Harper San Francisco, 1996.
Alter, Robert, and Kermode, Frank, eds. *The Literary Guide to the Bible.* Belknap, 1987.
Freedman, David N., and others, eds. *The Anchor Bible Dictionary.* 6 vols. Doubleday, 1992.
Gordon, Cyrus H., and Rendsburg, Gary A. *The Bible and the Ancient Near East.* 4th ed. Norton, 1997.
Keck, Leander, and others, eds. *The New Interpreter's Bible.* Abingdon, 1994-. Multivolume work.
Kee, Howard C., and others. *The Cambridge Companion to the Bible.* Cambridge, 1997.
Metzger, Bruce M., and Coogan, M. D., eds. *The Oxford Companion to the Bible.* Oxford, 1993.

Bible Society, American, is a nonprofit organization that translates, publishes, and distributes Bibles and parts of the Bible throughout the world. Since it was founded in 1816, the society has distributed more than 5 billion Bibles and portions of the Bible in more than 500 languages. Copies are also available in large print, braille, and on cassettes.

The society works with other Bible societies in many countries. The work of the American Bible Society is assisted nationwide by more than 66,000 volunteers and financed by gifts from living donors and also by income from endowments. The society publishes the *American Bible Society Record.* Headquarters of the American Bible Society are in New York City.

Critically reviewed by the American Bible Society

Bibliography, *BIHB lee AHG ruh fee,* is a list of books or articles about a subject. There is usually a bibliography at the end of a good nonfiction book or long article. The bibliography refers the reader to other writings that give more information on the subject.

The term *bibliography* can also mean a list of books that is written by a particular author. This type of bibliography is frequently found in the front of books. The word *bibliography* in Greek means *the writing,* or *copying, of books.*

One current type of bibliography presents a systematic description of books as well as lists them. It tells what each book is about and how it is bound. If several editions have been printed, this fact is noted. Book collectors use such bibliographies to identify rare old books and determine their value.

The World Book Encyclopedia has lists of books for

additional reading at the end of more than 1,500 articles. For example, see **Bible** (Additional resources).

Charles F. Sieger

Bibliothèque Nationale de France, *BEEB lee oh TEHK nah syoh NAL duh frahns,* is one of the largest libraries in Europe. It is located in Paris and is the national library of the French people. Collections in the Bibliothèque include millions of printed volumes, engravings and photographs; hundreds of thousands of magazines, manuscripts, and maps; and films, videos, coins and cameos.

Many of the manuscripts in the Bibliothèque were once in the Royal Library of King Charles V (Louvre library), which was begun in 1367 by Charles. Other items belonged to the library of the royal Valois family, in Blois. In the 1500's, King Francis I united the library from Blois with his own library in Fontainebleau. Charles IX brought the library to Paris. Mohammed M. Aman

Bicameral legislature. See **Legislature.**

Bicarbonate of soda, *by KAHR buh niht* ($NaHCO_3$), also known as *baking soda* and *sodium bicarbonate,* is a stomach alkalizer and soothes skin irritations. It is a source of carbon dioxide in baking powders and some fire extinguishers.

See also **Baking powder.**

Bicentennial Celebration, American, was a festival held throughout the United States, chiefly in 1976. It honored the 200th anniversary of the adoption of the Declaration of Independence by the Continental Congress on July 4, 1776. The celebration also honored various other events of the period of the Revolutionary War in America (1775-1783). Thousands of communities in all 50 states, plus groups from many other nations, took part in the celebration.

The activities of the Bicentennial were based on three major themes—Heritage '76, Festival USA, and Horizons '76. Heritage '76 urged Americans to recall the history and traditions of the United States. Activities based on this theme included art and museum exhibits, the reenactment of famous events of the Revolutionary War, and the restoration of historic buildings. Festival USA encouraged people to celebrate America as it was in 1976. Its activities included concerts, exhibits, and fairs. Horizons '76 urged communities to carry out various improvement projects. Such projects included beautification of parks, construction of cultural centers, and renewal of local neighborhoods.

Many U.S. cities planned major Bicentennial celebrations. In Philadelphia, the activities included the restoration of an area near Independence Hall, the building in which the Declaration of Independence was signed. Among the programs planned in the Boston area were the reenactment of famous Revolutionary events, such as Paul Revere's ride and the Battle of Bunker Hill. In Washington, D.C., the Smithsonian Institution scheduled an exhibition that dramatized life during the Revolutionary War.

The American Revolution Bicentennial Administration, established by Congress in 1973, directed the overall planning of the celebration. Each state also established a Bicentennial organization.

Biceps. See **Arm; Muscle.**

Bichat, Marie François Xavier, *bee SHAH, ma REE frahn SWAH gzah VYAY* (1771-1802), was a French surgeon, anatomist, and physiologist. He was the first scientist to base anatomy and physiology on the study of tissues rather than of organs. Bichat was one of the founders of *histology,* the study of the minute structure of animal and vegetable tissues. He also urged the use of autopsies in studying diseases and performed more than 600 autopsies himself.

Bichat also influenced philosophic thought of the 1800's. In *Physiological Researches on Life and Death* (1800), he defined life as "the sum total of forces that resist death." He denied that life could be understood simply in terms of physical laws. Bichat was born in Thoirette, near Oyonnax. Matthew Ramsey

Bichon frise, *BEE shahn frih ZAY,* is a breed of small, lively dog. A bichon frise stands from 8 to 12 inches (20 to 30 centimeters) high and weighs from 12 to 15 pounds (5.4 to 7 kilograms). It is white, often with tan, cream, or orange-yellow markings. The bichon frise has a soft, dense undercoat as well as an outer coat of coarser, curly guard hairs. Together, the coats have a velvety feel.

The bichon frise is descended from the barbet, or water spaniel. The breed developed in Spain about 200 B.C.

Mar-Jon's

The bichon frise makes an affectionate pet.

It later became popular with royalty there as well as in France and Italy. Francisco Goya, a Spanish painter of the late 1700's and early 1800's, included the dog in many of his works.

Critically reviewed by the Bichon Frise Club of America

Bickerdyke, Mary Ann Ball (1817-1901), was an American Civil War hospital worker who became known as *Mother Bickerdyke.* She was born in Knox County, Ohio, and studied nursing in Cincinnati. Bickerdyke moved to Galesburg, Illinois, in 1856. During the Civil War (1861-1865), she cared for the sick and wounded on battlefields and in Union Army hospitals. After the war ended, Bickerdyke helped obtain pensions for veterans and Civil War nurses. She also did missionary work in New York. A monument to her memory stands in Galesburg, where she and her husband are buried.

Kenneth R. Manning

Bickerstaff Papers. See **Swift, Jonathan.**

Bicuspid. See **Teeth** (Permanent teeth; picture).

Bicycle riding provides recreation and exercise for the entire family. Mountain bikes, *shown here,* are sturdy vehicles suitable for riding on rough terrain.

© Nancie Battaglia, NewSport

Bicycle is a vehicle with two wheels set one behind the other on a frame. A rider powers a bicycle by pushing two pedals around in a circle. People all over the world use bicycles for transportation, recreation, and exercise. Several of the world's countries produce millions of bicycles per year.

In some nonindustrial countries, the bicycle is a more important means of transportation than the automobile because it costs far less. Some people use the bicycle to make a living. In many Asian countries, for example, *pedicabs* provide public transportation. These vehicles consist of a bicycle with an attached cart that can carry two passengers. Bicycles also are used to deliver small packages and mail.

Kinds of bicycles

Bicycles come in many sizes and styles. There are separate sizes for children's and adult bicycles. The size of a children's bicycle is the diameter of its wheels. The main sizes are 12, 16, 20, and 24 inches. The size of an adult bicycle is determined by the size of its frame. It is typically measured as the length of the *seat tube.* This tube, which is part of the frame, is a cylinder that extends from just below the seat to the axle of the pedals. Standard sizes of adult bikes vary depending on the type. Some types of adult bikes are typically measured in inches, and others in centimeters. There are five main styles of bicycles: (1) mountain, (2) road, (3) hybrid, (4) juvenile, and (5) specialty.

Mountain bikes have sturdy frames, flat handlebars, and wide, knobby tires. These features make them suitable for rides over rough terrain. Some even have front and rear *suspensions* (spring systems), like those of motorcycles, to cushion against bumps. Wheel size is usually 26 inches. Mountain bikes have gear systems that provide up to 27 speeds.

Road bikes are made for riding on pavement. They have narrow tires set on wheels of 26 or 27 inches, or of a similar size known as 700C. They have curved handlebars, and their gear systems provide up to 30 speeds. There are four major types of road bikes. *Road racers* weigh about 20 pounds (9 kilograms). Their lightness and short *wheelbase* (length from front to rear axle) enable the cyclist to make quick movements with the bike. *Touring bikes* weigh from 23 to 26 pounds (10.5 to 12 kilograms). They have fenders and attachments for racks. They also have a long wheelbase that adds stability for carrying belongings in bags called *panniers (PAN ee uhrz). Road/sport bikes* are made for fast recreational riding and light touring. They are not as quick as racers. They weigh 22 to 25 pounds (10 to 11 kilograms). *Comfort bikes,* also called *cruiser bikes,* are made for casual riding. They weigh 26 pounds (12 kilograms) or more. They may have one speed or several.

Hybrids are a cross between a mountain bike and a road bike. They are designed for road and off-road cycling. Many people ride hybrids to work or school. Hybrid tires are wider than road bike tires but narrower than mountain bike tires. Hybrids may have flat or curved handlebars. Their gear systems provide up to 27 speeds.

Juvenile bikes are designed for children. Some are smaller versions of adult mountain, road, and hybrid models. Two popular types are *BMX* and *freestyle.* BMX bikes are designed for racing on dirt tracks, a sport called *bicycle motocross.* Freestyle bikes have small frames for trick riding.

Specialty bicycles have uncommon features. The *tandem* carries two riders, one behind the other. Each rider uses a separate set of pedals, but there is only one chain. The riders pedal together for extra power and speed. On a *recumbent,* the rider leans backward and pedals with the legs stretched forward. Some recumbents have an outer shell that reduces air resistance, enabling the bicycle to reach speeds of more than 60 miles (100 kilometers) per hour.

How a bicycle works

Power and speed. When the rider pushes the pedals, they turn a crank. The crank has one or more *sprockets* (toothed wheels) called *chainrings* or *chainwheels.* A chain fits around the chainring and extends to a smaller

sprocket, called a *cog,* on the rear wheel. As the chainring turns, it moves the chain. The moving chain turns the cog, which turns the rear wheel. This action gives the bicycle a forward motion.

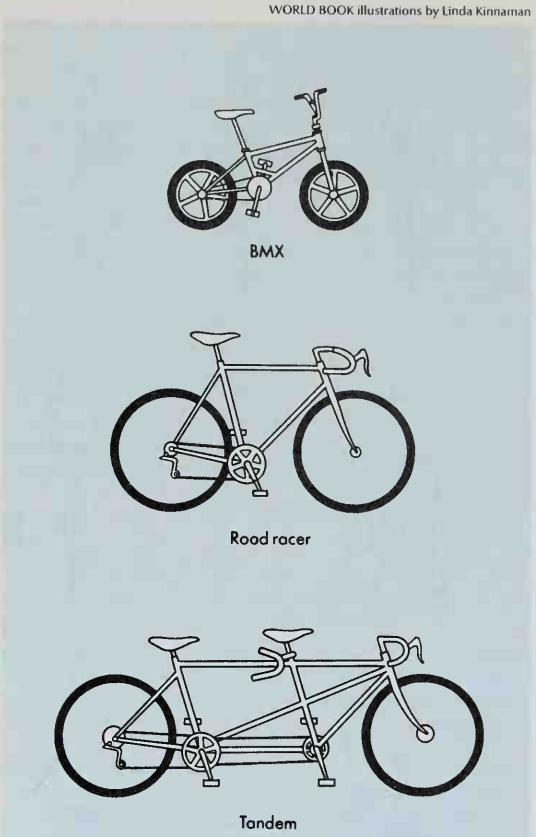
A bicycle's gear system helps the rider handle different situations. Low gears make it easier to pedal uphill or against the wind. They use a small chainring and a large rear cog. With each turn of the pedals, the rear wheel rotates only a little, and the bike travels slowly. High gears produce greater speed, especially when pedaling downhill or before a wind. They use a large chainring and a small cog. The rear wheel rotates many times with each turn of the pedals. This makes pedaling harder.

There are two types of gear systems. The most common type consists of the chain, chainrings and cogs of various sizes, front and rear shifting devices called *derailleurs (dih RAY luhrz),* and two control levers and shift cables. The levers are on the handlebar or frame. The rider shifts gears by moving either lever while pedaling. This action makes a derailleur move the chain from one chainring or cog to another. The number of gears equals the number of chainrings multiplied by the number of cogs. For example, a 24-speed bicycle has 3 chainrings and 8 cogs. The other type of gear system has one chainring, and as many as seven gears inside the rear wheel's hub. A lever on the handlebar is used to shift gears. The rider does not need to be pedaling to shift gears.

Steering and stopping. The rider uses the handlebar to steer the bicycle, and the brakes to stop it. Most bicycles have *caliper* brakes on both wheels. Caliper brakes stop the bike by pressing two brake pads against the rim of the wheel. A rider operates these brakes by squeezing levers on the handlebar. Some bicycles have *coaster* brakes, which the rider operates by pushing backward on the pedals.

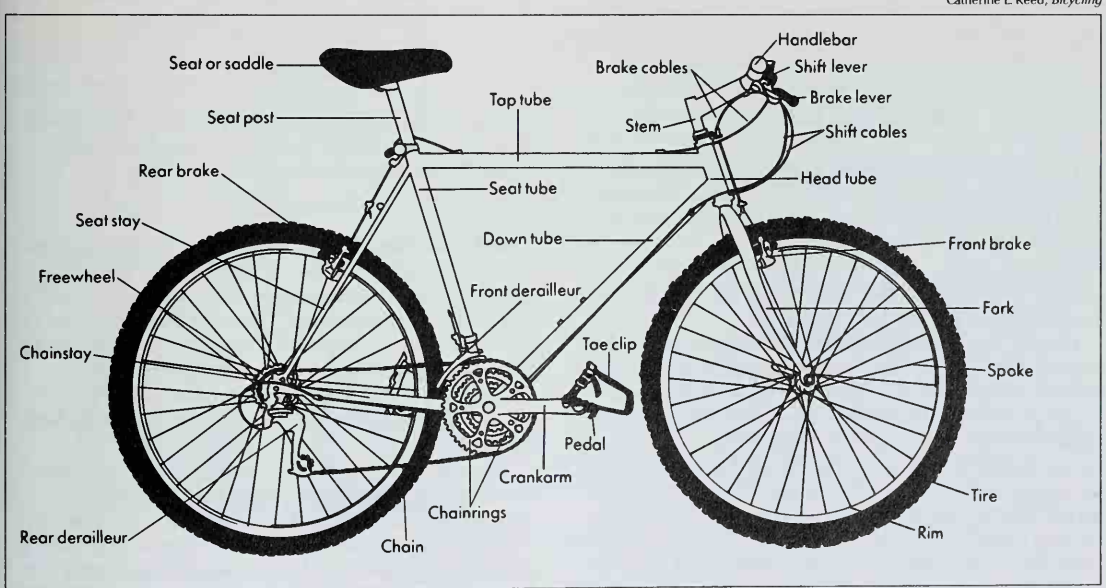
Some kinds of bicycles

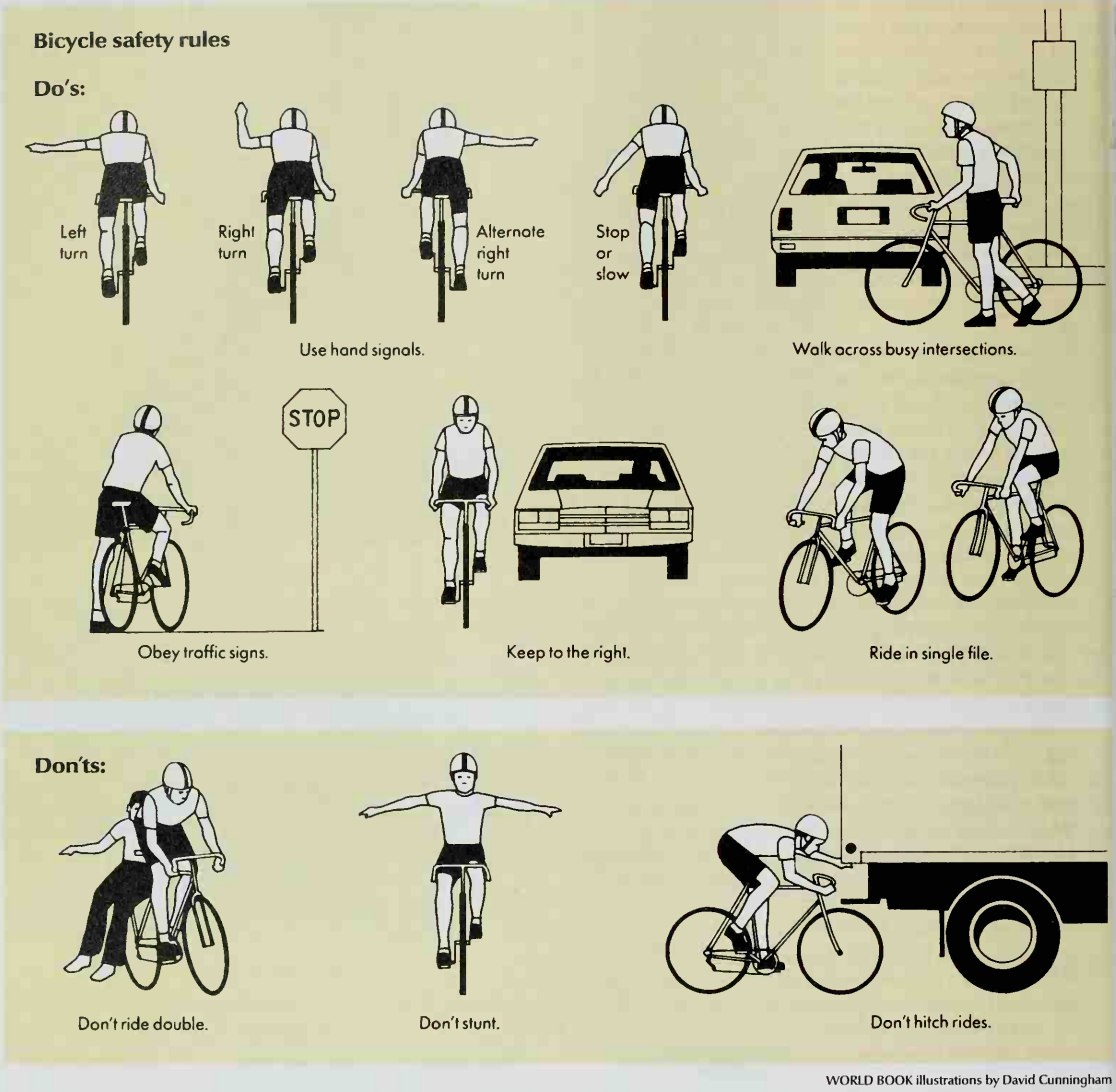
WORLD BOOK illustrations by Linda Kinnaman



Bicycle parts

Catherine L. Reed, *Bicycling*





WORLD BOOK illustrations by David Cunningham

Bicycle care and safety

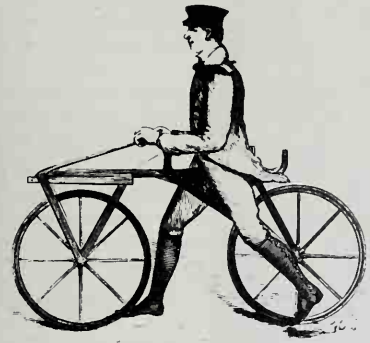
In most countries, bicycles must meet certain safety standards. Common standards require bicycles to have front and rear reflectors, and wheel reflectors visible from the side of the bike. Each tire should be inflated to the recommended air pressure. The brakes and gears should work easily. A bell or horn can be used to warn pedestrians of the bicycle's approach.

Bicycle riders should obey all traffic laws. Cyclists should also signal when slowing, stopping, or turning. In the United States, for example, standard signals include positioning the left arm down for a stop, and straight out for a left turn. For a right turn, cyclists may either extend the left arm with the hand pointed upward or extend the right arm straight out. When riding in the street, cyclists should ride in the same direction as automobile traffic and stay close to the edge of the road. They should not race, do stunts, or hold on to other vehicles. A cyclist should not carry passengers on a bicycle built for a single rider. Many people die in bicycle accidents each year. These deaths often involve head injuries. Cyclists should always wear helmets.

History

Early bicycles. The bicycle's first direct ancestor was the *draisine (dray ZEEN)* or *drasienne (dray zee EHN).* This scooterlike vehicle, made about 1817 by Baron Karl von Drais of Germany, had a steering bar connected to the front wheel. A Scottish blacksmith named Kirkpatrick Macmillan added pedals to the draisine in 1839, thus producing the first bicycle. Pierre Lallemont, a French mechanic, took out the first U.S. patent on a pedal bicycle in 1866.

About 1870, a new bicycle called the *high-wheeler, Ordinary,* or *penny-farthing* appeared. It had a huge front wheel and a small rear wheel. The front wheel of these bicycles was up to 5 feet (1.5 meters) high. Each turn of the pedals turned the front wheel around once, so the bike traveled a long distance with a single turn of



Historical Pictures Service

The draisienne, about 1817

Historical Pictures Service

Pierre Lallement's pedal-powered bicycle, 1866

Historical Pictures Service

High-wheeler, 1870's

Culver

Safety bicycle, 1880's

the pedals. The high-wheeler and other early models had solid tires made of iron or rubber.

About 1885, J. K. Starley, an English bicycle manufacturer, produced the first commercially successful *safety bicycle.* This bicycle had wheels of equal size, which made it easier and safer to ride than a high-wheeler. It also had a chain-and-sprocket system. By 1890, wheels made of air-filled rubber tires had replaced solid wheels. The coaster brake and adjustable handlebar also came into use around this time.

By the late 1800's, millions of people rode bikes. But during the early 1900's, the rapid development of the automobile caused many people to lose interest in cycling.

Bicycle riding today is popular among people interested in improving physical fitness and reducing air pollution. Many enjoy the challenge of mountain biking. Today, a number of communities have special bicycle lanes in parks and alongside streets. Many local bicycle clubs and national bicycle associations organize recreational rides for cyclists of all abilities. Ed Pavelka

See also **Bicycle racing; Pedicab; Unicycle.**

Additional resources

Level I

Erlbach, Arlene. *Bicycles.* Lerner, 1994.
Francis, John. *Bicycling.* Raintree Steck Vaughn, 1996.
King, Andy. *Fundamental Mountain Biking.* Lerner, 1996.

Level II

Dodge, Pryor. *The Bicycle.* Flammarion, 1996.
Glowacz, Dave. *Urban Bikers' Tricks and Tips.* Wordspace, 1998.
Perry, David B. *Bike Cult: The Ultimate Guide to Human-Powered Vehicles.* Four Walls, 1995.

Bicycle racing, also called *cycling,* is one of the most popular sports in the world. Cycling is especially popular in Europe, where millions of fans follow the feats of great cyclists. Bicycle racing has been an event in the Olympic Games since the modern games originated in 1896. The United States Cycling Federation, in cooperation with the National Off-Road Bicycle Association and the U.S. Professional Racing Organization, controls most of the organized bicycle racing events in the United States.

There are four main kinds of bicycle races—*track races, road races, off-road races,* and *motocross races.* Each kind requires a distinct type of bicycle.

Track races are held on oval tracks made of wood or concrete called *velodromes.* The distance around such tracks ranges from 140 to 500 meters (459 to 1,640 feet). On most cycling tracks, the track slopes inward. The slope steepens at both ends of the track. Velodromes may be located indoors or outside.

Track events may include races for individual cyclists, for teams of two or four, or for 30 or more cyclists at one time. Most races take place on outdoor tracks. These races can be individual *sprints* (short races) as short as 200 meters (650 feet). Other races are as long as 50 kilometers (31 miles). Some races are *time trials,* in which racers compete against the clock over a set distance. The *match sprint* and *pursuit* are races that involve tactics and endurance as well as speed.

A track bicycle has no brakes and only one gear. Its weight ranges from 14 to 18 pounds (6.4 to 8.2 kilograms). The cyclist slows down or stops by pushing back on the pedals.

Iris/Mons from Allsport

Road races are held outdoors between towns or around a course for a set number of laps. The most popular road race is the annual Tour de France, *shown here,* in which cyclists from several countries race through western Europe.

Road races are the original, and most popular, forms of bicycle racing. Hundreds of cyclists may start a race. They race over a course between two towns, or around a specific route for a set number of laps.

The most popular road race is the annual Tour de France in which almost 200 contestants race through western Europe. The Tour lasts 23 days and covers about 2,500 miles (4,000 kilometers). The distance is divided into sections called *stages.* Cyclists are timed in each stage. The cyclist with the lowest total time for all the stages wins. The event was dominated by Europeans until Greg LeMond of the United States won the Tour in 1986, 1989, and 1990.

The bicycles that are commonly used in road races have frames made of lightweight steel, aluminum, titanium, and carbon fiber tubing. They have brakes, gears, and narrow tires. The bikes weigh about 20 pounds (9 kilograms).

Off-road races began in the United States in the 1980's after the invention of the mountain bike. Mountain bikes have sturdy frames, multiple gears, and wide, knobby tires for extra traction. Some mountain bikes have *suspensions* (spring systems) to provide cushion against road shock.

Most off-road races are held on dirt trails, but any unpaved ground can be used. In one popular event, racers follow a specially designed course for a set number of laps. Specialty events include downhill races, uphill races, and *observed trials,* in which a rider must slowly guide the bicycle through an obstacle course without putting a foot on the ground. A well-known off-road bicycle race is the annual winter Iditabike in Alaska, in which racers follow a portion of the snow-packed Iditarod Sled Dog Trail. The race covers 210 miles (338 kilometers).

Bicycle motocross races became popular in the 1970's, especially among young people in the United States. The sport is popular in Europe and Australia. The races are often called *BMX* (*bi*cycle *m*oto-*cross*). They are held on dirt tracks less than $\frac{1}{4}$ mile (400 meters) long. The tracks have many bumps and sharp turns. The cyclists ride bicycles that have small wheels and wide

Steven E. Sutton, Duomo

Track races are held on oval tracks called *velodromes.* Velodromes may be located indoors or outdoors. Track events include races for individuals, for teams of two or four, and for as many as 30 or more cyclists. In a time trial, racers are timed over a certain distance.

tires to help prevent them from slipping in the turns. Bicycle motocross racers wear full helmets and padded clothing for protection against falls, which occur frequently. Joe Kita

See also **Olympic Games** (table: Cycling); **Triathlon.**

Biddle, Nicholas (1786-1844), was an American banker. He engaged in a "Bank War" against President Andrew Jackson. Biddle became president of the Bank of the United States in 1823. President Jackson vetoed a bill to renew the bank's charter in 1832. Biddle won political support by granting easy loans to politicians and editors, but could not make Jackson change his stand. Biddle was also a poet, scholar, and statesman. He was born in Philadelphia. Richard E. Ellis

Bieber, *BEE buhr,* **Owen Frederick** (1929-), served as president of the United Automobile Workers (UAW) from 1983 to 1995. The UAW is one of the largest labor unions in the United States. Bieber succeeded Douglas Fraser, who retired. He was the first UAW president who did not take part in the early struggles of the union, which was founded in 1935.

In 1984, Bieber negotiated far-reaching agreements between the UAW and the major car manufacturers. He used numerous local strikes rather than a single nationwide walkout as a major bargaining tool. Bieber made job security the main issue instead of pay increases. He won the first contracts that ensured company-financed retraining or other help for automobile workers who lost their jobs because of certain mass layoffs or because of automation. He was elected a director of the Chrysler Corporation in 1984.

Bieber was born in North Dorr, Michigan, near Grand Rapids. His father was an automobile worker. Owen Bieber joined the UAW in 1948, after he went to work for a company that made automobile parts. He was elected president of his local union in the Grand Rapids area in 1956. Bieber later joined the international UAW staff and in 1974 became the UAW regional director for western Michigan. In 1980, he was elected vice president of the UAW and given responsibility for its relations with General Motors Corporation, the largest automobile producer in the world. James G. Scoville

Biedermeier, *BEE duhr MY uhr,* is the name of a style of design that developed in the German-speaking countries of Europe during the early 1800's. The name came from a humorous character in German popular literature of the 1830's. "Papa Biedermeier" stood for family life, conservative values, and solid, comfortable living. The term *Biedermeier* was applied to architecture, interior design, and the decorative arts. Today, it is chiefly associated with comfortable German furniture for the home that was produced between 1820 and 1850.

Biedermeier furniture was an adaptation of the Empire style of France in the early 1800's. Both styles shared simple design and plain outlines. But the Biedermeier version was lighter in scale and color, emphasizing yellowish-brown fruitwood. Decoration featured simple carved designs or plain applied ornaments in contrasting brass or wood. John W. Keefe

See also **Furniture** (The Biedermeier and Restauration styles).

Biennial, *by EHN ee uhl,* is a plant that requires two years or two growing seasons to complete its life cycle. In the first season, the seeds of biennial plants sprout and grow, producing leaves and roots. During the winter, the plants remain dormant. The next spring and summer, they bear flowers, produce seed, and then die. Thus, biennial plants make and store food in the first growing season and reproduce in the second.

Several common vegetables, including beets, carrots, parsley, parsnips, and turnips, are biennials. People harvest these vegetables during or soon after the first growing season. Joseph E. Armstrong

See also **Annual; Gardening** (Cultivating an outdoor garden); **Perennial.**

Blenville, *BYAN VEEL* or *bee EHN VIHL,* **Sieur de** (1680-1768), a French-Canadian explorer and administrator, played a leading role in the European settlement of Louisiana. He served as governor of Louisiana from 1701 to 1712 and from 1732 to 1743. He was acting governor of the colony from 1716 to 1717. As leader of the French colony, Bienville displayed considerable skill in maintaining good relations with neighboring Indians. He provided the leadership that turned Louisiana from an isolated outpost into an established colony.

Bienville was born in Montreal. His given and family name was Jean-Baptiste Le Moyne. He received the title Sieur de Bienville in 1691. In 1699, he and his brother Iberville explored the region around the mouth of the Mississippi River. Bienville founded Mobile, Alabama, in 1702, and New Orleans in 1718. D. Peter MacLeod

See also **Iberville, Sieur d'.**

Bierce, Ambrose Gwinett (1842-1914?), was an American writer and journalist. He became best known for his realistic war stories and for his tales of horror and the supernatural. Bierce developed a crisp and precise writing style. The characters in his stories are driven by the lowest instincts. Many act like animals, with little conscience. The stories show the author's lifelong fascination with cruelty and death.

Bierce's most famous collection of stories is *Tales of Soldiers and Civilians* (1891). From 1881 to 1906, he wrote hundreds of satirical word definitions for a newspaper column. Many of these definitions were collected in *The Cynic's Word Book* (1906), later published as *The Devil's Dictionary.*

Bierce was born to poverty-stricken parents on a farm in Meigs County, Ohio. He fought courageously for the North in the Civil War (1861-1865) and was seriously wounded. The effects of his early poverty and brutal war experiences intensified his naturally gloomy temperament. He gained the nickname of "Bitter Bierce." In 1866, Bierce settled in San Francisco, where he became a journalist. His brilliant and cynical writings made him one of the most feared and powerful literary figures in California. In 1897, Bierce moved to Washington, D.C., to become a columnist for the chain of newspapers published by William Randolph Hearst. Bierce disappeared while on a trip to Mexico, and the circumstances of his death remain unknown. Ronald T. Curran

Bierstadt, *BEER stat,* **Albert** (1830-1902), was one of the greatest American romantic landscape painters. He first viewed the scenic grandeur of the American West in 1859, while traveling with a surveying expedition. He made on-the-spot sketches and took photographs that he later developed into large panoramas of Western mountains. Loosely based on his sketches and photos, his paintings expressed the grandeur of the landscape,

Detail of *The Rocky Mountains* (1863), an oil painting on canvas; Metropolitan Museum of Art, New York City, Rogers Fund, 1907

A Bierstadt painting shows a panoramic view of the Rocky Mountains. Bierstadt gained fame during the mid-1800's for his monumental romantic landscapes of the American West. These paintings were praised for their many details as well as for their vast scale.

emphasized by his use of dramatic lighting. Bierstadt received $25,000 for one painting, the highest price paid for an American painting at that time. His reputation declined, however, late in his career. Today, his paintings, especially those on a smaller and more controlled scale, are popular because of a new interest in the romantic movement of the 1800's.

Bierstadt was born in Solingen, Germany. He was brought to New Bedford, Massachusetts, as a baby.

Sarah E. Boehme

Bifocals. See Glasses.

Big and Little Dippers are the names of two groups of stars that are easy to recognize in the northern sky. They are shaped like long-handled cups, or dippers.

The Big Dipper consists of seven stars that can be used to point to other parts of the sky. For example, an imaginary line extended northward from the two stars at the front of the cup points to Polaris, the North Star (see North Star). The line points to the constellation Leo when extended southward. An easy way to find Leo is to imagine water leaking from the bottom of the cup and falling on the lion.

The Big Dipper forms part of the constellation of Ursa Major, the Great Bear. The cup forms the hindquarters of the bear, the handle forms the tail, and fainter stars outline the head and legs. The star Mizar, located at the center of the handle, has a nearby companion star named Alcor. These two stars have been used for hundreds of years as a test for keen eyesight. Viewed through a telescope, Mizar appears as two stars (see Binary star).

The Little Dipper forms almost the entire constellation of Ursa Minor, the Little Bear. It consists mostly of faint stars. As a result, it is hard to find unless the sky is very dark. But the Little Dipper has long been important as an indicator of north, because the North Star lies at the end of this dipper's handle.

In Greek mythology, Ursa Major is the nymph Callisto and Ursa Minor is her son Arcas. One myth says Zeus loved Callisto and thus angered his wife, Hera. When Hera tried to kill her, Zeus changed Callisto into a bear. Arcas was unaware that the bear was his mother and tried to kill her. Zeus changed Arcas into a bear and put both bears into the sky to protect them. Writers around the year 1600 said the bears had long tails because Zeus pulled them into the sky by the tail.

Position of the dippers. On January evenings, the Little Dipper is west of the Big Dipper. The Little Dipper's handle points up and the Big Dipper's, down. On July evenings, the positions are reversed. The dippers' positions also change at night because of the earth's rotation.

David H. Levy

Big bang refers to the most widely held scientific theory of the origin of the universe. According to this theory, the universe began with a hot, explosive event—a "big bang"—about 10 billion to 20 billion years ago. At the beginning of the event, all the matter that existed was much smaller than the nucleus of an atom. Matter then expanded rapidly and is still expanding. British cosmologist Fred Hoyle originated the term *big bang* in 1950.

One key piece of evidence for the big bang is the observed amount of helium in the universe. In 1948, Russian-born physicist George Gamow and his collaborators, American physicists Ralph A. Alpher and Robert

Herman, worked out in detail the nuclear reactions that would have occurred during the big bang. They found that only hydrogen and helium would have remained in any significant amounts following the first few minutes of the explosion. Their calculations indicated that about 25 percent of the mass of the normal matter now present in stars and galaxies is helium. Astronomical observations have since confirmed this calculation.

Gamow and his collaborators also determined that the big bang would have given rise to a certain kind of radiation known as *thermal radiation* or *blackbody radiation.* This radiation would then have cooled as the universe expanded. In 1965, American physicists Arno Penzias and Robert Wilson detected this radiation. They found that its temperature is about 2.7 Celsius degrees above absolute zero (−459.67 °F, or −273.15 °C), very close to what Gamow and his colleagues had calculated. The thermal radiation comes from all directions, and its temperature is almost exactly the same in all directions.

The original big bang theory does not indicate how the temperature of the radiation could have become so uniform. An added theory called *cosmic inflation* proposes an explanation, however. According to this theory, the universe expanded by an enormous amount in the early moments of the big bang. The theory shows that the inflationary expansion would have tended to smooth out temperature variations occurring over widely separated parts of the universe. Small variations in density would have led to the formation of galaxies.

Today, the universe appears to be expanding at an accelerating rate. The factor responsible for the acceleration is thought to be a repelling force that is uniformly present throughout the universe. The source of this force, called the *cosmological constant,* was first proposed by German-born physicist Albert Einstein. He made his proposal in 1917, in a paper that applied the general relativity theory to the universe.

Kenneth Brecher

See also Cosmology; Relativity; Universe.

Big Ben is the name given to the bell, clock, and clock tower of the Houses of Parliament in the Palace of Westminster in London. The tower, also called St. Stephen's Tower, stands 316 feet (96 meters) tall.

The clock weighs about 5 $\frac{1}{2}$ tons (5 metric tons). Each of the four clock faces is 23 feet (7 meters) in diameter. Each hour hand is 9 feet (2.7 meters) long, and each minute hand is 14 feet (4.3 meters) long. The numbers are 2 feet (0.6 meter) high. The bell can be heard at a distance of 9 miles (14 kilometers).

The tower was completed in 1858, after an 1834 fire destroyed most of the original Palace of Westminster. The name *Big Ben* at first referred to the bell in the tower. Some historians believe the bell was named after Sir Benjamin Hall, commissioner of works when the tower was built. Andrew Church

Big Bend National Park is the last great wilderness area of Texas. It is one of the few places where geologic processes are so clearly shown that an untrained person can begin to understand them. The Chisos Mountains, in the park, were created by volcanic action in the Age of Dinosaurs and by the later action of erosion. Boquillas, Mariscal, and Santa Elena canyons reveal geologic history for the past 100 million years. Fossil trees millions of years old are found in the park. Relics of an ancient cave dweller civilization and of the later Comanche Indians have been found by archaeological expeditions to the park area. Vast stretches of desert land surround the Chisos Mountains. Animal life in Big Bend National Park includes bobcats, mountain lions, collared peccaries, pronghorns, and the tiny Carmen Mountains white-tailed deer.

The park was created in 1944, after Texas donated the land to the federal government. It was named for the Big Bend of the Rio Grande, the park's southern boundary. For area, see National Park System (table: National parks). Critically reviewed by the National Park Service

See also Texas (picture).

Big Bend State. See Tennessee.

Big Brothers/Big Sisters of America is a nonprofit social welfare organization that coordinates the programs of about 480 agencies in the United States. The programs assist children primarily between 6 and 16 years old who come from single-parent homes. Professional caseworkers pair each child with an adult volunteer who provides guidance and friendship.

The movement to form such an organization began in 1902. A national federation for boys and girls was created in 1917 but discontinued in 1937. In 1946, Big Brothers of America was organized for boys only. Big Sisters of America was formed in 1970. In 1977, the two groups merged. Headquarters are in Philadelphia.

Critically reviewed by Big Brothers/Big Sisters of America

Big Five refers to the five permanent members of the Security Council of the United Nations (UN). These are China, France, Russia, the United Kingdom, and the United States. The Soviet Union held a permanent council seat until the nation broke up into a number of inde-

James Lemass, Gamma/Liaison

Big Ben is the name given to the bell, clock, and clock tower of London's Houses of Parliament. Big Ben is a well-known London landmark. The huge bell tolls on the quarter-hour.

pendent countries in 1991. That same year, Russia, which had been part of the Soviet Union, took over the Soviet seat.

Nationalist China (Taiwan) held a seat on the Security Council until 1971, when it was expelled from the United Nations. At that time, the People's Republic of China (Communist China) was admitted to the United Nations and given a permanent seat on the Security Council.

Robert J. Pranger

See also **United Nations** (The Security Council).

Big Three. See **World War II** (The strategy).

Big top. See **Circus**.

Bigamy, *BIHG uh mee,* is the crime a man or woman commits by being married to two people at the same time. If a man deliberately takes a second wife when his first wife is neither dead nor legally divorced, he is guilty of bigamy (see **Divorce**). A woman taking a second husband under the same circumstances is equally guilty. Bigamous marriages have no legal force.

A person may believe the first spouse dead, and remarry without deliberate intent of bigamy. If the first spouse reappears, proof must be offered that there was a false report of death or that there has been no knowledge of the first spouse's existence for a specified period, usually from five to seven years. When this proof is accepted, the law in most states does not consider such a remarriage bigamous. In some states, the remarried person may choose between the two spouses. In others, the second marriage must be annulled.

In the United States, the punishment for bigamy is usually a term of imprisonment. Length of imprisonment may vary from two to five years, and imprisonment is sometimes accompanied by a fine. The penalty in England was reduced in the time of George I to a minimum of two years' imprisonment with hard labor. Before that time, bigamy in England was a crime punishable by death. In America, the death penalty for bigamy lasted through colonial days.

Aidan R. Gough

Bigfoot is a humanlike creature said to live in the Pacific Northwest. Bigfoot has been reported most often in the mountains of California, Oregon, and Washington, and of British Columbia in Canada. Canadians call it *Sasquatch.* Bigfoot stories resemble those about the Abominable Snowman, a hairy beast said to live in the Himalaya and other mountainous areas of central and northeastern Asia (see **Abominable Snowman**).

Hundreds of people have reported seeing the bigfoot or its footprints. They describe the creature as standing from 7 to 10 feet (2 to 3 meters) tall and weighing more than 500 pounds (230 kilograms). Like an ape, it has thick fur, long arms, powerful shoulders, and a short neck. It supposedly walks like a human being and leaves footprints that measure about 16 inches (41 centimeters) long and about 6 inches (15 centimeters) wide.

The evidence for the bigfoot's existence has so far not been sufficient to convince most scientists. Many believe that some evidence, which includes footprints and photographs, has been faked.

Daniel Cohen

Additional resources

Coleman, Loren, and Huyghe, Patrick. *The Field Guide to Bigfoot, Yeti, and Other Mystery Primates Worldwide.* Avon, 1999.

Krantz, Grover S. *Bigfoot Sasquatch Evidence.* Hancock Hse., 1999.

Bighorn is a species of wild sheep found only in North America. Male bighorn sheep have massive horns that curve backward from the forehead, down, and then forward. The horns may measure more than 4 feet 2 inches (1.3 meters) long, with a circumference of up to about 17 inches (43 centimeters) at the base. Female bighorns have very short horns that are only slightly curved.

Bighorns are also called *mountain sheep.* They live in mountains from east-central British Columbia in Canada to Baja California in northwestern Mexico. Bighorns that inhabit the slopes of the Rocky Mountains and Sierra Nevada are dark grayish-brown in color. Those that live farther south in the mountains of the desert have coats of pale buff. All bighorns are creamy-white on the lower parts of their bodies, with patches of creamy-white on their rumps.

The size of bighorns varies, depending on their sex and the regions in which they live. The *rams* (males) generally are much larger than the *ewes* (females). In the northern mountains, bighorn rams may stand up to 3 $\frac{1}{2}$ feet (107 centimeters) high at the shoulder and may weigh up to 300 pounds (140 kilograms). Ewes in this region typically weigh less than 160 pounds (73 kilograms). In the desert mountains, rams rarely weigh more than 200 pounds (90 kilograms) and most ewes weigh less than 120 pounds (54 kilograms).

John W. Matthews, DRK Photo

A bighorn ram has massive, curved horns. Bighorn sheep live in mountains from east-central British Columbia to northwestern Mexico.

Male bighorns usually live in groups of 2 to 15 animals. Females and young live in separate groups, usually of 5 to 30 animals. During the mating season, rams often engage in long, spectacular fights. In these battles, which may last for hours, two or more rams repeatedly charge at one another and fiercely crash their horns together. Typically, the male ram with the largest horns wins.

Ewes bear one lamb about 175 days after mating. Male bighorns reach maturity at about 7 to 8 years of age. Females mature at about age 4.

Bighorns feed on grasses and low shrubs. Their chief enemies include wolves, coyotes, and mountain lions. Bighorns also are endangered by diseases of livestock and by the spread of industrial developments, which have destroyed much of the animal's habitat.

Another species of North American wild sheep, called *Dall's sheep* or *thinhorn,* is closely related to the bighorn. Dall's sheep are smaller than bighorns and have more slender horns. They live in Alaska and in the Yukon Territory and British Columbia. They range in color from white in the northernmost part of their range to black in the southernmost part. Dark brown or black Dall's sheep are also called *Stone's sheep.*

Valerius Geist

Scientific classification. The bighorn belongs to the family Bovidae. Its scientific name is *Ovis canadensis.* Dall's sheep is *Ovis dalli.*

Bignonia, *bihg NOH nee uh,* is the name of an American family of climbing shrubs, vines, and trees. Bignonias are found in warm climates and grow wild in the Eastern and Southern United States. Their colorful flowers are trumpet-shaped. The *trumpet creeper* is one of the most beautiful bignonias. Daniel F. Austin

Perry D. Slocum, Earth Scenes

The trumpet creeper, shown here, is a member of the bignonia family. This plant has trumpet-shaped blossoms. The bignonia family includes flowering vines, shrubs, and trees.

Scientific classification. Bignonias belong to the bignonia family, Bignoniaceae. The scientific name for the trumpet creeper is *Campsis radicans.*

See also Calabash; Catalpa; Jacaranda.

Bihzad, *BEE zahd,* **Kamal ad-Din,** *KAY mahl ahd DEEN* (1450-1537), was the most famous of the Persian miniature painters. He illustrated many famous Persian manuscripts, among them the *Timur Namah,* Saadi's *Gulistan,* and Nizami's *Khamsa.* He excelled in drawing battle scenes full of dramatic movements. He also painted romantic and lyric nature scenes with delicacy and beauty. His pupils brought his style of painting to Herat (now in Afghanistan), Bukhara in central Asia, and India. Bihzad was born in Herat, and moved later to Tabriz. There, he became a favorite of the Safawid Shahs (rulers) Ismail and Tahmasp. Elizabeth deS. Swinton

Bike. See Bicycle; Motorcycle.

Bikini Atoll, *buh KEE nee,* is an isolated *atoll* (ring-shaped reef) located in the northwest Marshall Islands group in the Pacific Ocean. For the atoll's location, see **Pacific Islands** (map). Bikini's approximately 54-mile (87-kilometer) length of reef encircles a lagoon. Large breaks in the reef allow ships to enter and exit the lagoon. There are 26 *islets* (tiny islands) on Bikini's reef. The islets cover 2.32 square miles (6.01 square kilometers) of land.

After World War II ended in 1945, the United States moved the atoll's population to Rongerik and later to Kili so it could use the atoll for nuclear bomb tests. After the United States announced in 1968 that the radiation had been reduced to a safe level, some people returned to Bikini. In 1978, the Bikinians won a lawsuit against the U.S. government, requiring that the United States conduct a scientific survey to determine if the atoll was fit for human life. That same year, United States officials announced that radiation levels on the atoll were not safe, and the people were resettled elsewhere. Lawsuits filed against the United States for damage to health and property have resulted in financial compensation for the Bikinians. In 1988, the United States government approved a $90-million trust fund to be paid to the Bikinians for the rehabilitation and resettlement of the atoll.

Robert C. Kiste

See also Marshall Islands.

Biko, *BEE koh,* **Steve** (1946-1977), was a black leader in the fight against apartheid and white minority rule in South Africa. Biko was arrested for his political activities and died in prison. In 1997, several former police officers admitted involvement in Biko's death.

Stephen Bantu Biko was born in King William's Town, South Africa. In 1969, while attending medical school, he founded the South African Students' Organization. Through it, he helped lead what became known as the Black Consciousness Movement. This antiapartheid movement promoted self-reliance and self-respect among blacks. Biko argued that blacks could end white

Iskandar Visiting a Hermit, a miniature (1493?) from the *Khamsa* of Nizami; British Museum, London

A Bihzad painting reflects the emphasis on precise detail, perspective, and landscape elements typical of Persian art.

domination only if they freed themselves from self-doubt that had resulted from centuries of domination by whites. Large numbers of Biko's supporters took part in protests, strikes, and marches against the government. Because of Biko's popularity, the government began to view him as a security threat and arrested him in August 1977. He died in prison less than a month later. An autopsy showed that he died of untreated head injuries. Evidence indicated that Biko's jailers had caused the injuries. Stephen M. Davis

Bile is a fluid secreted by the liver. Bile helps the body digest and absorb fatty foods. In addition, it rids the body of certain waste products. The liver secretes bile continuously, producing about 1 quart (0.95 liter) daily. Bile flows from the liver into a tube called the *hepatic duct.* This tube connects with the *common bile duct,* which leads to the small intestine. Except after meals, however, most of the bile does not proceed directly to the intestine. Instead, it enters the *gallbladder,* a pouch attached to the common bile duct. There, the bile is stored and concentrated until needed. After fatty foods enter the small intestine, the gallbladder contracts, sending bile through the common bile duct and into the intestine.

Bile's digestive properties result from *bile salts,* which are manufactured by the liver from a fatty substance called *cholesterol.* Bile salts break up globs of fat into tiny particles that digestive enzymes in the small intestine can attack. Bile salts then temporarily link to the digested fats to speed up the absorption of fats through the intestinal wall. In addition, they help the body absorb the fat-soluble vitamins—vitamins A, D, E, and K. Most of the bile salts return to the liver through the bloodstream.

Bile contains various waste products that eventually become part of the *feces* (solid body wastes). One of these waste products, *bilirubin,* is formed from the breakdown of red blood cells. It is joined with fat-soluble chemicals in the liver to form a product that is discharged in the bile. Bilirubin gives bile its color, which ranges from brown to greenish-yellow. Other waste matter in the bile includes excess cholesterol and certain medicines and poisons that the liver removes from the blood. James L. Franklin

See also **Gallbladder.**

Bilharziasis. See **Schistosomiasis.**

Bilingual education is teaching and learning in two languages—one that a student already speaks and a new language. Students in bilingual programs learn their new language by using it in a broad range of subjects, including math, science, social studies, and language arts. In traditional foreign language study, students use their new language only in their foreign language class.

Bilingual education has existed in various forms throughout the world for many centuries. Approaches to bilingual education differ chiefly in the grade at which a new language is introduced or ended; the amount of teaching conducted in each language; and the degree to which students who are native speakers of the two languages mix with one another.

Two-way bilingual education programs, also called *dual language programs* or *developmental bilingual education,* teach subjects through two languages to all participating students. For example, a program in the United States might combine English-speaking students with native Spanish speakers. These students would progress together through all the grade levels in the program, with some subjects taught in Spanish and others in English. Because students who are fluent in each language work together, these programs provide many chances for participants to help one another learn the new language and master grade-level subjects.

Immersion education is a type of bilingual program that continues from kindergarten through grade 12. This approach was developed in Canada to help students become fluent in both French and English. Although English is Canada's *majority language* (the language spoken by most people), both English and French are officially recognized. As a result, many parents want their children to develop proficiency in both.

Transitional bilingual education provides support for students who speak a language other than the majority language. Transitional programs teach students some subjects in their native language while they learn the majority language through other subjects. In most such programs, students move into full-time instruction in the majority language after three or four years.

Issues in bilingual education. Bilingual education is increasing throughout the world as parents see value in their children's acquiring a second language for future work, travel, or personal relations. In many countries, such programs teach in English and the country's majority language. Many educators see academic value in bilingual education. Some studies show that students who spend at least six years in two-way programs score higher on school tests than those schooled in only one language. Some people oppose bilingual education because they fear it may lead to loss of national identity. In the United States, another concern is the shortage of bilingual teachers. Virginia P. Collier

See also **Education** (Bilingual education); **Hispanic Americans** (Education); **Multiculturalism.**

Additional resources

Baker, Colin. *Foundations of Bilingual Education and Bilingualism.* 2nd ed. Multilingual Matters, 1996.
Dicker, Susan J. *Languages in America: A Pluralist View.* Multilingual Matters, 1996.
Edwards, John R. *Multilingualism.* Routledge, 1994.
Ehrman, Madeline E. *Understanding Second Language Learning Difficulties.* Sage, 1996.

Bill comes from the Latin word *bulla,* a seal used on documents during the Middle Ages. Gradually the word came to be used for the paper itself. In England and France, the similar words *bill* and *billet* meant less formal writing as well. In English, the term refers to many written or printed papers. These are bills of *attainder, exchange, health, rights,* and *sale.* Posters and theater programs are called bills. In the United States, a *bill* also means paper money. Some important forms of bills include:

In bookkeeping, a company may receive *promissory notes, drafts,* and *bills of exchange.* If these are made payable to the company, the bookkeeper records them as *bills receivable.* Notes given or drafts accepted by the firm are entered as *bills payable.*

In commerce, after goods are sold, the buyer receives a *statement* (bill of money due). An *invoice* (bill of goods) is also usually sent. It contains a list of the goods

sold, the price of each item, and the terms of the sale, such as discounts and shipping charges.

In law, a person is formally accused of crime in a written statement known as a *true bill* or a *bill of indictment.* Several other legal statements are also called bills.

In lawmaking, a U.S. senator or representative proposes a new law by *introducing a bill.* See **United States, Government of the** (How a bill becomes law).

In transportation, the *bill of lading* is the principal document in the transaction between carrier and shipper. It acts as a receipt, as routing instructions, and as evidence of ownership of the goods. Another document, the *waybill,* is issued by land and air carriers. It accompanies the shipment and contains a detailed description of the goods. In water transportation, waybills are often called *manifests.* Jay Diamond

Related articles in *World Book* include:

Attainder	Bill of rights	Note
Bill of health	Bill of sale	Veto

Bill of exchange is a written order signed by the party drawing it, which directs a second party to pay to a third party a fixed sum of money at a certain time. The word *party* may refer to an individual, a bank, or a corporation. The party that orders the bill of exchange is called the *maker,* or *drawer,* of the bill. The second party is the *drawee,* and the third party is the *payee.* Sometimes the drawer of the bill may order that payment be made to the drawer.

A bill payable on receipt is called a *sight* or *demand bill* or a *check.* A bill payable at a specified future time is called a *time bill.* This type of bill is presented to the drawee. When accepted, the bill becomes an *acceptance.* The drawee is then legally required to pay the payee the amount shown on the bill.

Bills of exchange are often used to finance the movement of goods within a country or between one country and another. To take title to the goods, the drawee must pay the amount specified in the bill. The drawee must pay immediately if it is a sight bill. If it is a time bill, the drawee can accept it and pay later.

Bills drawn on bankers are called *banker's bills.* Bills arising out of financial transactions between bankers are called *finance bills,* and those on merchants, *mercantile bills.* Those relating to commercial or nonfinancial transactions are called *trade bills.* Joanna H. Frodin

See also **Check; Draft; Negotiable instrument** (Forms).

Bill of health is a certificate issued and signed by designated port authorities. It certifies the state of health of the ship's crew and passengers, and its sanitary condition at the time the ship sailed. Vessels are kept in quarantine when cases of contagious diseases are on board or when fumigation is needed.

When a vessel arrives at a port of entry, it is considered in quarantine until a *pratique* (permission to communicate) has been granted. A *free pratique* permits a vessel the right of entry without further quarantine restrictions. A *provisional pratique* specifies the conditions that permit issuance of a free pratique. Most ports generally grant all ships free pratique unless the port authorities believe arriving passengers or crew are infected with, or have been exposed to, contagious diseases.

The term *clean bill of health* is also often used to indicate that a person suspected of some wrongdoing has been found guiltless. Alan R. Hinman

Bill of rights is a document that describes the fundamental liberties of the people. It also forbids the government to violate these rights. The constitutions of many democratic countries have bills of rights that guarantee everyone the freedoms of speech, of religion, and of the press, and the right of assembly.

Individuals are considered to be born with certain *inalienable rights*—that is, rights that governments may not take away from them. These rights are considered part of a "higher law," a body of universal principles of right and justice that is superior to laws created by governments. Some of these rights, such as the freedoms of speech and of the press, support democracy. Others, such as the right to trial by jury, are essential to justice.

Many of these ideas were developed in ancient Greek and Roman civilizations. In modern history such individuals as the philosophers John Locke and John Stuart Mill, the writers John Milton and Thomas Paine, and the statesmen Thomas Jefferson and James Madison fought for the acceptance of these views.

The United States Constitution, adopted in 1788, contained few personal guarantees. James Madison led in the adoption of 10 amendments that became known as the *Bill of Rights.* The bill came into effect on Dec. 15, 1791. This day is celebrated as Bill of Rights Day (see **Bill of Rights Day**).

The first 8 amendments contain the fundamental rights and freedoms of every citizen. The 9th Amendment forbids the government to limit freedoms and rights that are not listed in the Constitution. The 10th Amendment limits the powers of the federal government to those that are granted to it in the Constitution.

The U.S. Supreme Court decides if a law restricts any liberties listed in, or implied by, the Bill of Rights. However, it has not stated exactly which rights are implied. The Supreme Court has held that under the 14th Amendment most of the Bill of Rights also applies to state governments.

The freedoms and rights of individuals, however, are not without limits. For example, freedom of speech does not protect a person who shouts "Fire" in a crowded theater when there is no fire. The Supreme Court has held that freedom of speech may be limited only when its exercise creates a "clear and present danger" to society.

State constitutions. Each state constitution contains a bill of rights or declaration of rights. Some state bills of rights are more extensive than the federal bill of rights. Virginia adopted the first state bill of rights in 1776.

Canada's constitution includes a bill of rights called the *Canadian Charter of Rights and Freedoms.* The charter took effect on April 17, 1982. Previously, Canada had a bill of rights that applied only to areas under federal jurisdiction and did not bind provincial governments.

The charter guarantees freedom of speech, religion, assembly, and other basic rights. It also guarantees democratic government and bans discrimination based on race, ethnic or national background, color, religion, age, sex, or mental or physical disability.

The charter establishes the right of every Canadian citizen to move freely from one province to another and guarantees other mobility rights. It declares that English and French are the official languages of Canada and have equal status in Parliament, the courts, and the government of Canada. All of the rights in the Canadian

Charter of Rights and Freedoms are guaranteed equally to men and women.

A key provision of the charter centers on minority language educational rights. Under this provision, English- and French-speaking parents can have their children educated, "where numbers warrant," in their own language. Officials of the province of Quebec oppose the minority language provision. They argue that it restricts the province's power over education and its ability to preserve the French culture. The majority of Quebec's people by far are of French descent, and they prefer that most children there be educated in French.

The charter's protections extend to citizens in all of Canada's provinces and territories. A clause in the charter allows Parliament and the provincial legislatures to pass laws overriding certain rights that are guaranteed. However, such laws must be renewed every five years.

English Bill of Rights. In 1689, Parliament presented to King William III and Queen Mary a declaration that became known as the *Bill of Rights*. It stands with Magna Carta and the Petition of Right as the legal guarantees of English liberty. The Bill of Rights listed rights that were the "true, ancient, and indubitable rights and liberties of the people" of the English kingdom. It settled the succession to the throne and limited the king's powers in taxation and keeping up a standing army.

In 2000, the United Kingdom (U.K.) began enforcing the Human Rights Act of 1998. This act incorporates into U.K. law most of the European Convention for the Protection of Human Rights and Fundamental Freedoms. This convention is an international agreement on human rights signed by members of the Council of Europe in 1950. By including provisions of the convention in a law of its own, the U.K. provided its citizens with a specific list of freedoms similar to those in the U.S. Bill of Rights.

French bill of rights. The French adopted the Declaration of the Rights of Man and of the Citizen in 1789. This document attempted to define the revolutionary war cry of "Liberty, Equality, Fraternity." It guarantees religious freedom, freedom of speech and of the press, and personal security. This bill of rights has been added to the French Constitution.

The United Nations General Assembly adopted the Universal Declaration of Human Rights on Dec. 10, 1948. The declaration asserts that all persons are equal in dignity and rights, and have the right to life, liberty, and security. It also lists certain social and cultural rights.

Barry Cooper and Peter Woll

Related articles in *World Book* include:

Constitution of the U.S.
Fifteenth Amendment
Fifth Amendment
Freedom of assembly
Freedom of religion
Freedom of speech
Freedom of the press
Human rights
Human Rights, Universal Declaration of
Human Rights Watch
Magna Carta
Petition of Right
Second Amendment

Additional resources

Krull, Kathleen. *A Kids' Guide to America's Bill of Rights.* Avon, 1999. Younger readers.

Levy, Leonard W. *Origins of the Bill of Rights.* 1999. Reprint. Yale, 2001.

United States Bill of Rights

Amendment 1

Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech, or of the press; or the right of the people peaceably to assemble, and to petition the government for a redress of grievances.

Amendment 2

A well-regulated militia, being necessary to the security of a free state, the right of the people to keep and bear arms shall not be infringed.

Amendment 3

No soldier shall, in time of peace, be quartered in any house without the consent of the owner; nor in time of war but in a manner to be prescribed by law.

Amendment 4

The right of the people to be secure in their persons, houses, papers and effects, against unreasonable searches and seizures, shall not be violated, and no warrants shall issue but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.

Amendment 5

No person shall be held to answer for a capital or otherwise infamous crime, unless on a presentment or indictment of a grand jury, except in cases arising in the land or naval forces, or in the militia, when in actual service in time of war or public danger; nor shall any person be subject for the same offense to be twice put in jeopardy of life or limb; nor shall be compelled in any criminal case to be a witness against himself, nor be deprived of life, liberty, or property, without due process of law; nor shall private property be taken for public use, without just compensation.

Amendment 6

In all criminal prosecutions the accused shall enjoy the right to a speedy and public trial, by an impartial jury of the state and district wherein the crime shall have been committed, which district shall have been previously ascertained by law, and to be informed of the nature and cause of the accusation; to be confronted with the witnesses against him; to have compulsory process for obtaining witnesses in his favor, and to have the assistance of counsel for his defense.

Amendment 7

In suits at common law, where the value in controversy shall exceed twenty dollars, the right of trial by jury shall be preserved, and no fact tried by a jury shall be otherwise reexamined in any court of the United States than according to the rules of the common law.

Amendment 8

Excessive bail shall not be required, nor excessive fines imposed, nor cruel and unusual punishments inflicted.

Amendment 9

The enumeration in the Constitution of certain rights shall not be construed to deny or disparage others retained by the people.

Amendment 10

The powers not delegated to the United States by the Constitution, nor prohibited by it to the states, are reserved to the states respectively, or to the people.

Canadian Charter of Rights and Freedoms

Whereas Canada is founded upon principles that recognize the supremacy of God and the rule of law:

Guarantee of Rights and Freedoms

1. The *Canadian Charter of Rights and Freedoms* guarantees the rights and freedoms set out in it subject only to such reasonable limits prescribed by law as can be demonstrably justified in a free and democratic society.

Fundamental Freedoms

2. Everyone has the following fundamental freedoms:
- (*a*) freedom of conscience and religion;
- (*b*) freedom of thought, belief, opinion and expression, including freedom of the press and other media of communication;
- (*c*) freedom of peaceful assembly; and
- (*d*) freedom of association.

Democratic Rights

3. Every citizen of Canada has the right to vote in an election of members of the House of Commons or of a legislative assembly and to be qualified for membership therein.

4. (1) No House of Commons and no legislative assembly shall continue for longer than five years from the date fixed for the return of the writs at a general election of its members.

(2) In the time of real or apprehended war, invasion or insurrection, a House of Commons may be continued by Parliament and a legislative assembly may be continued by the legislature beyond five years if such continuation is not opposed by the votes of more than one-third of the members of the House of Commons or the legislative assembly, as the case may be.

5. There shall be a sitting of Parliament and of each legislature at least once every twelve months.

Mobility Rights

6. (1) Every citizen of Canada has the right to enter, remain in and leave Canada.

(2) Every citizen of Canada and every person who has the status of a permanent resident of Canada has the right
- (*a*) to move to and take up residence in any province; and
- (*b*) to pursue the gaining of a livelihood in any province.

(3) The rights specified in subsection (2) are subject to
- (*a*) any laws or practices of general application in force in a province other than those that discriminate among persons primarily on the basis of province of present or previous residence; and
- (*b*) any laws providing for reasonable residency requirements as a qualification for the receipt of publicly provided social services.

(4) Subsections (2) and (3) do not preclude any law, program or activity that has as its object the amelioration in a province of conditions of individuals in that province who are socially or economically disadvantaged if the rate of employment in that province is below the rate of employment in Canada.

Legal Rights

7. Everyone has the right to life, liberty and security of the person and the right not to be deprived thereof except in accordance with the principles of fundamental justice.

8. Everyone has the right to be secure against unreasonable search or seizure.

9. Everyone has the right not to be arbitrarily detained or imprisoned.

10. Everyone has the right on arrest or detention
- (*a*) to be informed promptly of the reasons therefor;
- (*b*) to retain and instruct counsel without delay and to be informed of that right; and
- (*c*) to have the validity of the detention determined by way of *habeas corpus* and to be released if the detention is not lawful.

11. Any person charged with an offence has the right
- (*a*) to be informed without unreasonable delay of the specific offence;
- (*b*) to be tried within a reasonable time;
- (*c*) not to be compelled to be a witness in proceedings against that person in respect of the offence;
- (*d*) to be presumed innocent until proven guilty according to law in a fair and public hearing by an independent and impartial tribunal;
- (*e*) not to be denied reasonable bail without just cause;
- (*f*) except in the case of an offence under military law tried before a military tribunal, to the benefit of trial by jury where the maximum punishment for the offence is imprisonment for five years or a more severe punishment;
- (*g*) not to be found guilty on account of any act or omission unless, at the time of the act or omission, it constituted an offence under Canadian or international law or was criminal according to the general principles of law recognized by the community of nations;
- (*h*) if finally acquitted of the offence, not to be tried for it again and, if finally found guilty and punished for the offence, not to be tried or punished for it again; and
- (*i*) if found guilty of the offence and if the punishment for the offence has been varied between the time of commission and the time of sentencing, to the benefit of the lesser punishment.

12. Everyone has the right not to be subjected to any cruel and unusual treatment or punishment.

13. A witness who testifies in any proceedings has the right not to have any incriminating evidence so given used to incriminate that witness in any other proceedings, except in a prosecution for perjury or for the giving of contradictory evidence.

14. A party or witness in any proceedings who does not understand or speak the language in which the proceedings are conducted or who is deaf has the right to the assistance of an interpreter.

Equality Rights

15. (1) Every individual is equal before and under the law and has the right to the equal protection and equal benefit of the law without discrimination and, in particular, without discrimination based on race, national or ethnic origin, colour, religion, sex, age or mental or physical disability.

(2) Subsection (1) does not preclude any law, program or activity that has as its object the amelioration of conditions of disadvantaged individuals or groups including those that are disadvantaged because of race, national or ethnic origin, colour, religion, sex, age or mental or physical disability.

Official Languages of Canada

16. (1) English and French are the official languages of Canada and have equality of status and equal rights and privileges as to their use in all institutions of the Parliament and government of Canada.

(2) English and French are the official languages of New Brunswick and have equality of status and equal rights and privileges as to their use in all institutions of the legislature and government of New Brunswick.

(3) Nothing in this Charter limits the authority of Parliament or a legislature to advance the equality of status or use of English and French.

17. (1) Everyone has the right to use English or French in any debates and other proceedings of Parliament.

(2) Everyone has the right to use English or French in any debates and other proceedings of the legislature of New Brunswick.

18. (1) The statutes, records and journals of Parliament shall be printed and published in English and French and both language versions are equally authoritative.

(2) The statutes, records and journals of the legislature of New Brunswick shall be printed and published in English and French and both language versions are equally authoritative.

19. (1) Either English or French may be used by any person in, or in any pleading in or process issuing from, any court established by Parliament.

(2) Either English or French may be used by any person in, or in any pleading in or process issuing from, any court of New Brunswick.

20. (1) Any member of the public in Canada has the right to communicate with, and to receive available services from, any head or central office of an institution of the Parliament or government of Canada in English or French, and has the same right with respect to any other office of any such institution where

(*a*) there is a significant demand for communications with and services from that office in such language; or

(*b*) due to the nature of the office, it is reasonable that communications with and services from that office be available in both English and French.

(2) Any member of the public in New Brunswick has the right to communicate with, and to receive available services from, any office of an institution of the legislature of government of New Brunswick in English or French.

21. Nothing in sections 16 to 20 abrogates or derogates from any right, privilege or obligation with respect to the English and French languages, or either of them, that exists or is continued by virtue of any other provision of the Constitution of Canada.

22. Nothing in sections 16 to 20 abrogates or derogates from any legal or customary right or privilege acquired or enjoyed either before or after the coming into force of this Charter with respect to any language that is not English or French.

Minority Language Educational Rights

23. (1) Citizens of Canada

(*a*) whose first language learned and still understood is that of the English or French linguistic minority population of the province in which they reside, or

(*b*) who have received their primary school instruction in Canada in English or French and reside in a province where the language in which they received that instruction is the language of the English or French linguistic minority population of the province,

have the right to have their children receive primary and secondary school instruction in that language in that province.

(2) Citizens of Canada of whom any child has received or is receiving primary or secondary school instruction in English or French in Canada, have the right to have all their children receive primary and secondary school instruction in the same language.

(3) The right of citizens of Canada under subsections (1) and (2) to have their children receive primary and secondary school instruction in the language of the English or French linguistic minority population of a province

(*a*) applies wherever in the province the number of children of citizens who have such a right is sufficient to warrant the provision to them out of public funds of minority language instruction; and

(*b*) includes, where the number of those children so warrants, the right to have them receive that instruction in minority language educational facilities provided out of public funds.

Enforcement

24. (1) Anyone whose rights or freedoms, as guaranteed by this Charter, have been infringed or denied may apply to a court of competent jurisdiction to obtain such remedy as the court considers appropriate and just in the circumstances.

(2) Where, in proceedings under subsection (1), a court concludes that evidence was obtained in a manner that infringed or denied any rights or freedoms guaranteed by this Charter, the evidence shall be excluded if it is established that, having regard to all the circumstances, the admission of it in the proceedings would bring the administration of justice into disrepute.

General

25. The guarantee in this Charter of certain rights and freedoms shall not be construed so as to abrogate or derogate from any aboriginal, treaty or other rights or freedoms that pertain to the aboriginal peoples of Canada including

(*a*) any rights or freedoms that have been recognized by the Royal Proclamation of October 7, 1763; and

(*b*) any rights or freedoms that now exist by way of land claims agreements or may be so acquired.

26. The guarantee in this Charter of certain rights and freedoms shall not be construed as denying the existence of any other rights or freedoms that exist in Canada.

27. This Charter shall be interpreted in a manner consistent with the preservation and enhancement of the multicultural heritage of Canadians.

28. Notwithstanding anything in this Charter, the rights and freedoms referred to in it are guaranteed equally to male and female persons.

29. Nothing in this Charter abrogates or derogates from any rights or privileges guaranteed by or under the Constitution of Canada in respect of denominational, separate or dissentient schools.

30. A reference in this Charter to a province or to the legislative assembly or legislature of a province shall be deemed to include a reference to the Yukon Territory and the Northwest Territories, or to the appropriate legislative authority thereof, as the case may be.

31. Nothing in this Charter extends the legislative powers of any body or authority.

Application of Charter

32. (1) This Charter applies

(*a*) to the Parliament and government of Canada in respect of all matters within the authority of Parliament including all matters relating to the Yukon Territory and Northwest Territories; and

(*b*) to the legislature and government of each province in respect of all matters within the authority of the legislature of each province.

(2) Notwithstanding subsection (1), section 15 shall not have effect until three years after this section comes into force.

33. (1) Parliament or the legislature of a province may expressly declare in an Act of Parliament or of the legislature, as the case may be, that the Act or a provision thereof shall operate notwithstanding a provision included in section 2 or sections 7 to 15 of this Charter.

(2) An Act or a provision of an Act in respect of which a declaration made under this section is in effect shall have such operation as it would have but for

the provision of this Charter referred to in the declaration.

(3) A declaration made under subsection (1) shall cease to have effect five years after it comes into force or on such earlier date as may be specified in the declaration.

(4) Parliament or a legislature of a province may reenact a declaration made under subsection (1).

(5) Subsection (3) applies in respect of a reenactment made under subsection (4).

Citation

34. This Part may be cited as the *Canadian Charter of Rights and Freedoms.*

Bill of Rights Day commemorates the acceptance of the Bill of Rights as amendments to the United States Constitution. Its purpose is to make Americans increasingly aware of their rights and responsibilities as citizens. President Franklin D. Roosevelt proclaimed December 15 as Bill of Rights Day in 1941, and it has been observed nationally since then. Some states, including California and New York, set aside an entire week as Bill of Rights Week. The Bill of Rights is in the first 10 amendments. See also **Bill of Rights.** Jack Santino

Bill of sale is a formal written statement by which a seller transfers to a purchaser the title to an item of personal property. A bill of sale is necessary only if a state law requires it, or if both parties agree that the purchaser should receive one.

A few states require by law that a particular form of bill of sale be used. But most states have no such requirements. If no particular form of bill of sale is required, any clear and definite written statement of transfer of property, which is fully described, is legally acceptable. Such a statement must usually show the date, the names of the parties, a clear description of the property sold, and the sale cost of the property. The seller must sign the bill of sale, and some states require that this signature be acknowledged before a notary public (see **Notary public**). Jay Diamond

Billboard. See **Advertising** (Outdoor signs; picture); **Poster.**

Billiards is the name of several indoor games played on a rectangular table. Players shoot at plastic balls with a long tapered stick called a *cue.* In all billiard games, a player must first strike a special ball called the *cue ball* with the tip of the cue. The cue ball then must strike one or more other balls, known as *object balls,* to score points. In most billiard games, the table has openings called *pockets.* Players attempt to use the cue ball to drive object balls into the pockets.

The most common forms of billiards are *pool, snooker,* and *carom billiards.* Two or more players can compete in pool. Snooker is limited to two players. Two or three people can play carom billiards.

Pool is the most popular billiard game in the United States. It is played on a table with six pockets, one at each corner and one each on the longest sides of the table. A player tries to *sink* or *pocket* a specified ball by shooting it into a pocket. Most pool games are played with 15 object balls and a cue ball.

Snooker is an English pocket billiards game played on a table with six pockets similar to a pool table. The game is played with a cue ball and 21 object balls of various point values. Players try to outscore their opponent by pocketing balls of greater value.

Carom billiards is played on a table without pockets. Three or four balls are used: a white ball, one or two red balls, and a white ball with a dot. Players score points by *caroming* (striking) a cue ball off the object balls and the raised sides of the table in specified ways.

Billiards is both a popular form of recreation and an important competitive sport. Some tournaments offer prize money of more than $100,000. Expert players compete for world titles in several kinds of billiard games.

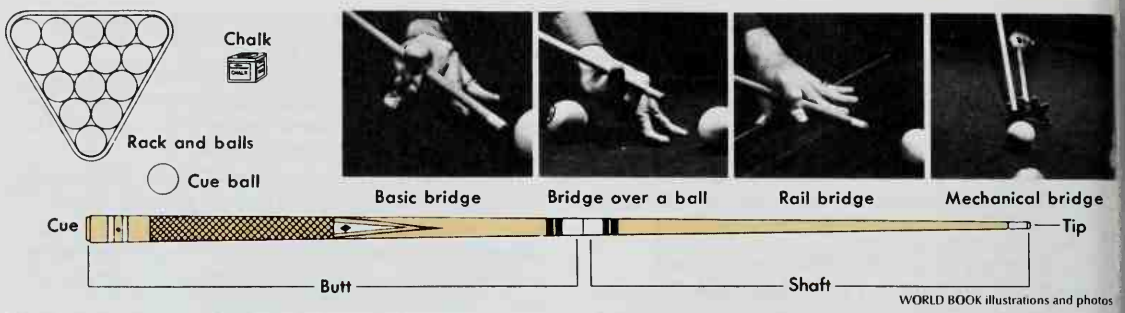
Equipment. Billiard tables vary in size, but all tables are twice as long as they are wide. American pool tables range in size from 3 feet by 6 feet (0.9 meter by 1.8 meters) to 5 feet by 10 feet (1.5 meters by 3 meters). English snooker tables are 6 feet by 12 feet (1.8 meters by 3.7 meters), while the American version is generally played on tables 5 feet by 10 feet. Most carom games are also played on tables that are 5 feet by 10 feet.

Billiard tables are solidly constructed pieces of furniture. The frame is normally made of dried wood to avoid warping. The top of the table, called the *bed,* is usually made of slate and can weigh as much as 800 pounds (360 kilograms). The raised sides of the table are called *rails.* They are made of wood with molded rubber cushions that allow balls to rebound off them. A cloth of blended nylon and wool covers the table and serves as the playing surface.

The size and shape of pockets on billiard tables vary with the game. In general, the openings are wide enough to accommodate two balls resting side by side. On American pool tables, the side pockets are slightly larger than the corner pockets. The American pool table pockets are somewhat pointed while the pockets on a

WORLD BOOK photo by Dan Miller

Billiards is an indoor game played on a rectangular table. In a popular type of billiards called *pool,* players use a cue to try to knock balls into one of six pockets. The player at the left is attempting to shoot a ball into a corner pocket.



Basic billiards equipment includes a rack, balls, and cue. Chalk rubbed on the cue tip prevents the cue from slipping off the ball and spoiling a shot. Players may form a *bridge* with their fingers to guide the cue, or they may use a mechanical bridge.

snooker table are more rounded. Snooker table pockets are also smaller than pool table pockets.

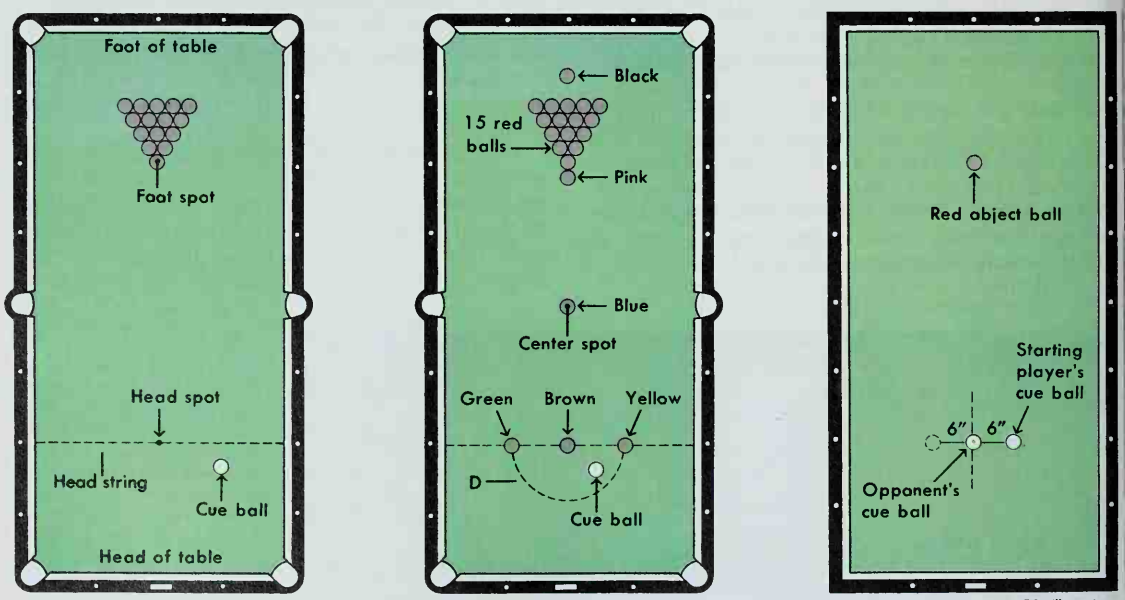
Billiard balls were once made of ivory. Today, they are manufactured from a durable plastic material. Most pool balls weigh from $5\frac{1}{2}$ to 6 ounces (160 to 170 grams) and have a diameter of $2\frac{1}{4}$ inches (5.7 centimeters). Snooker balls are slightly lighter and smaller. Balls used in carom billiards weigh from 7 to $7\frac{1}{2}$ ounces (200 to 210 grams).

Most cues are made from aged hardwoods. They vary in length and weight, but most are 57 inches (145 centimeters) long and weigh between 14 and 22 ounces (400 and 620 grams). At the thin end of the cue is the *cue tip,* a small leather attachment that allows the shooter to apply *English* (spin) to the cue ball. A rough substance called *chalk* can be applied to keep the tip from slipping off the cue ball when English is applied.

Pool is the general term for American pocket billiards games. The most widely played pool games are *14.1 continuous, 8-ball, Rotation,* and *9-ball.* The game of 14.1 continuous begins with 15 balls, numbered 1 through 15. They are *racked* (arranged) in a triangle at a position on the table called the *foot spot.* The first shooter must place the cue ball behind a line called the *head string* and drive it into the triangle of balls. This shot is called the *break.* The shooter scores a point by pocketing a numbered ball specified by the shooter in a certain pocket. Each player tries to reach a certain number of points before the opponent.

The game is called 14.1 continuous because play stops after the 14th ball has been pocketed. The 14 balls are then racked again without moving the 15th ball and the cue ball. Play then resumes. Players normally try to pocket the 15th ball in such a way that the cue ball breaks up the racked balls and increases the possibility of continuing their string of pocketed balls.

The game of 8-ball is the most popular pool game in the United States. The game begins in the same manner as the start of 14.1 continuous. After the break, the shooter attempts to sink all the balls that are numbered



Pool, American snooker, and billiards begin with the balls in certain positions on a table. The number of balls played, as well as their layout, differs with each of the three games.

1 through 7 or 9 through 15, followed by the 8 ball. To win, a player must pocket all the balls in a group and then the 8 ball. A player may shoot at any ball other than the 8 ball until the first ball is pocketed. That ball determines which player has the lower-numbered group and which has the higher-numbered group. If a player accidentally sinks the 8 ball before pocketing the other seven balls, he or she loses the game. If a player sinks the 8 ball on the break, the shooter can either re-rack the balls and break again, or *spot* (place) the 8 ball on the *foot spot.* A game is neither won nor lost when the 8 ball is pocketed on the break.

In rotation, players try to pocket balls of greater value than the opponents' balls. The only requirement is that the cue ball first must strike the lowest-numbered ball. The maximum number of points in a 15-ball game is 120. Therefore, the first player to score 61 points wins.

In 9-ball, only the balls numbered 1 through 9 are used. The balls are racked in a diamond shape with the 9 ball in the middle. The 1 ball sits at the point of the diamond on the foot spot and must be the first ball struck by the cue ball on the break. The lowest numbered ball on the table must be struck first on all shots. To win, a player must sink the 9 ball.

Snooker is played with 15 red balls and 6 "colored" balls. Each red ball is worth 1 point. The colored balls and their point values are yellow (2), green (3), brown(4), blue (5), pink (6), and black (7). Players try to outscore opponents by the time all balls have been pocketed.

The game begins when one player breaks from anywhere inside a small semicircle behind the head string. This semicircle is called the "D". On subsequent turns, the player must pocket a red ball before shooting at a colored ball. The colored balls must be pocketed in order of ascending value. A red ball and a colored ball cannot be pocketed on the same shot. The word *snooker* is a term that describes a layout of balls in which the path from the cue ball to the object ball is obstructed by a third ball.

Carom billiards games are played throughout the world. The most popular versions in the United States are *3-cushion* and *straight-rail* billiards. In both of these games, one player uses the white ball as the cue ball, and the opponent uses the dotted ball as the cue ball. At the start of the game, the white ball and the dotted ball are placed on the foot spot. In order to score a point in 3-cushion billiards, the shooter's cue ball must strike three or more cushions and one ball in any sequence before hitting the third ball. In straight-rail billiards, a player scores points by merely striking the other two balls with the cue ball. Michael E. Panozzo

Additional resources

Billiards: The Official Rules & Records Book. The Billiard Congress of Am. Published annually.

Mizerak, Steve, and Panozzo, M. E. *Steve Mizerak's Complete Book of Pool.* Contemporary Bks., 1990.

Billings (pop. 89,847; met. area pop. 129,352) is the largest city in Montana. It serves as a trade and transportation center for a large agricultural district called the "Midland Empire." It lies on the Yellowstone River, in south-central Montana (see Montana [political map]).

Leading economic activities in the Billings area include health-care services, petroleum refining, and tourism. Major airlines, railroads, and truck lines serve the city. Billings is the home of Montana State University-Billings and Rocky Mountain College.

Billings was founded in 1882, when the Northern Pacific Railroad (now part of the Burlington Northern and Santa Fe Railway) was built through the area. It was named for Frederick Billings, president of the railroad at that time.

During the 1970's, Billings became a center for the offices of coal-mining, petroleum, and other related businesses. The industries helped cause a population boom, resulting in several construction projects. An 18-story bank and office building—Montana's tallest—was completed in 1985. Billings has a council-manager government. Edward A. Kemmick

See also Montana (picture: A petroleum refinery).

Billings, Josh (1818-1885), was the pen name of Henry Wheeler Shaw, a popular American humorist. Billings specialized in humorous essays and *aphorisms,* which are short, clever statements of general truths. Billings expressed his humor in deliberately misspelled words and ungrammatical sentences, a technique popular among humorists of the time. However, Billings's language and images are fresh, original, and picturesque.

Billings was born in Lanesborough, Massachusetts. For 18 years, he wrote humorous columns for the New York *Weekly* newspaper. He made many speaking tours in the United States and Canada. David B. Kesterson

Billings, William (1746-1800), was the first professional musician and the first important composer born in the American Colonies. He stimulated interest in music, and his rhythmic, melodious choral pieces became widely popular. Billings published six volumes of his music. The first volume, *The New England Psalm Singer* (1770), was the first collection of original compositions written by an American.

Billings introduced many changes into the music of his time. He replaced slow, solemn church hymns with his own lively, simple music. He also introduced the use of the pitch pipe and cello in church music. He traveled throughout New England, teaching his music to singing schools that he organized in many towns. His tune "Chester" became popular among colonial soldiers during the Revolutionary War in America (1775-1783).

Billings was born in Boston. He was a self-taught musician. He succeeded despite a blind eye, a crippled arm and leg, and a harsh voice. Leonard W. Van Camp

Billion is a thousand million. One billion is written 1,000,000,000. This definition is used throughout *The World Book Encyclopedia* and is the standard definition in the United States. In some European countries and elsewhere, a billion can mean a million million, or 1,000,000,000,000. See also **Decimal system** (The decimal system and number words).

Billy the Kid (1859-1881) was a cattle thief and killer in New Mexico. He killed at least 5 men, though according to legends, he killed as many as 21. His real name was Henry McCarty, and he was born in New York City. His mother, Catherine McCarty, married William H. Antrim in 1873. The family settled in Silver City, New Mexico, and Henry often used his stepfather's name.

Young Henry fell into the wild life of the frontier after his mother died in 1874, and he shot a man to death in a quarrel near Fort Grant, New Mexico, three years later.

He became a fugitive after the killing and went to Lincoln County, New Mexico, using the name William H. Bonney. A rancher who befriended and employed him was killed in 1878 in a frontier feud, the Lincoln County cattle war. The Kid helped kill the murderers as a member of a special posse called *the Regulators.* The posse's legal standing was soon canceled, but the Kid's role in the feud grew larger. He stole livestock and took part in several skirmishes before agreeing to testify against other participants in the feud in exchange for a pardon. But Billy became afraid that state officials could not protect him from some men he planned to testify against, so he escaped. He continued his role as a rustler and killer.

Pat Garrett became Lincoln County sheriff in November 1880, and trapped Billy in December. Billy was convicted on April 9, 1881; he was sentenced to be hanged. He killed two deputies and escaped from jail on April 28. Sheriff Garrett found him in a house in Fort Sumner, a military post near the town of Fort Sumner, New Mexico, and killed him on July 14. Michael A. Lofaro

See also **Garrett, Pat.**

Additional resources

Green, Carl R., and Sanford, W. R. *Billy the Kid.* Enslow, 1992. Younger readers.

Nolan, Frederick W. *The West of Billy the Kid.* Univ. of Okla. Pr., 1998.

Biloxi, *bih LUHK see* (pop. 50,644), is the third largest city in Mississippi. Only Jackson and Gulfport have more people. Biloxi lies on the state's southern coast, along the Gulf of Mexico (see **Mississippi** [political map]).

Biloxi was one of the first permanent European settlements in the Mississippi Valley. The French Canadian explorer Pierre Le Moyne, Sieur d' Iberville, and his brother, Jean-Baptiste Le Moyne, Sieur de Bienville, brought settlers to the area in 1699. The name *Biloxi* comes from a Sioux Indian word for *first people.* Chief industries are casinos, tourism, and seafood processing. Gambling, fishing, and the city's artificially created beach attract visitors. Biloxi, Gulfport, and Pascagoula form a metropolitan area with a population of 363,988. Michael Tonos

Bin Laden, Osama (1957?-), is a Saudi-born millionaire and radical Muslim who supports international terrorism. He opposes United States policies in the Middle East, particularly U.S. support for Israel and the presence of U.S. troops in the Arabian Peninsula. He also opposes governments in the Islamic world that are allied to the United States. Bin Laden is the founder and leader of al-Qa'ida, a global terrorist organization that is allied with other Muslim extremist groups worldwide.

United States and other Western intelligence officials believe that bin Laden has been the mastermind behind a number of terrorist attacks against U.S. targets. The U.S. government named him as the prime suspect in the Sept. 11, 2001, attacks on the World Trade Center in New York City and the Pentagon Building near Washington, D.C. Officials also believe he was behind the 1998 bombings of U.S. embassies in Kenya and Tanzania.

Bin Laden was born in Riyadh, Saudi Arabia. In 1979, he joined the *mujahideen* (Muslim holy warriors) in Pakistan who were fighting against the Soviet occupation of Afghanistan. During much of the 1980's, he collected money and materials to support the mujahideen. In the late 1980's, he established al-Qa'ida to resist the Soviet occupation. During the 1990's, al-Qa'ida evolved into a worldwide terrorist network opposed to U.S. policies and influence in the Middle East. After the Soviets withdrew from Afghanistan in 1989, bin Laden reportedly returned to Saudi Arabia. But he was forced to leave in 1991 because of his opposition to the Saudi government. He lived in Sudan from 1991 until 1996. He then moved to Afghanistan, where he lived under the protection of the Taliban, a conservative Islamic group that controlled most of that country.

AP/Wide World

Osama bin Laden

After the September 2001 attacks, the United States demanded that the Taliban hand over bin Laden. The Taliban refused. The United States and its allies, including Afghan opposition rebels, began a military campaign against the Taliban. The Taliban government fell in late 2001, but the fate of bin Laden and several other al-Qa'ida leaders remained unknown. Christine Moss Helms

See also **Qa'ida, Al-; September 11 terrorist attacks; Taliban.**

Binary number. See Numeration system (The binary system).

Binary star, *BY nuhr ee,* or *double star,* is a pair of stars that are close together and cannot escape from each other. The stars hold each other captive by the force of gravity, and each one orbits around the other. The individual members of a few binaries can be seen without a telescope. But the stars in most binaries are so close together that they look like single stars. The binary star nearest Earth looks like a single star. It belongs to the triple-star system Alpha Centauri, 4.3 light-years from Earth (see **Alpha Centauri**).

Binaries reveal some traits of stars that cannot be seen in single stars. For example, the orbital motions of binaries indicate the masses of the stars. The greater a star's mass, the stronger its gravity and the faster it pulls its companion around in orbit. Studies of binaries show that some stars are probably 60 times as massive as the sun. Astronomers have also found stars so small that 15 of them together would barely equal the sun in mass.

The stars in some binaries are so close that they almost touch. In these binaries, the gravity of each star distorts its companion, causing enormous tides to form on the surfaces of both stars. Violent events can occur in such close pairs. One star may become an *X-ray pulsar,* a star that radiates X rays in precisely timed bursts. Other close pairs radiate powerful radio waves. In still other close pairs, one of the stars pulls matter upon itself from the other star. This accumulating matter may explode in nuclear reactions, causing the star to flare brightly. Some stars appear to orbit an invisible companion that may be a *black hole,* a star whose gravity is so strong that not even light can escape from it. Jeremy Mould

See also **Black hole; Pulsar; Star** (Binary stars; picture: Transfer of mass).

Bindweed, *BYND weed,* is the name of several species of plants that often grow as weeds. Bindweeds have

slender, twining stems several feet long, and small, arrow-shaped or heart-shaped leaves. The funnel-shaped flowers range in color from white to pink. The *hedge bindweed*, or *wild morning-glory*, grows along roads, in thickets, on beaches, and in fields. It is found throughout most of the United States and southern Canada, and in Europe and parts of Asia. Its flowers measure $1\frac{1}{2}$ to 3 inches (3.8 to 7.6 centimeters) long. See also **Morning-glory.** Daniel F. Austin

Scientific classification. The bindweeds are in the morning-glory family, Convolvulaceae. The scientific name for the hedge bindweed is *Calystegia sepium.*

Binet, *bih NAY,* **Alfred** (1857-1911), a French psychologist, did much to arouse interest in the psychological study of children. The French government asked him to devise a method of identifying children with mental retardation so that they could be given special schooling. With Théodore Simon, he developed the Binet-Simon intelligence tests. These were the first scales for measuring intelligence and determining "mental age." They enabled teachers to detect talented and subnormal children. Present-day intelligence tests are refinements of the original Binet-Simon tests.

Binet was born in Nice, France, in July 1857. As a young man he studied law, but a strong interest in biology soon led him to give up his law career. From biology he turned to psychology, particularly the study of abnormal and defective persons. Binet served as director of a clinic for experimental psychology at the Sorbonne University in Paris. He also promoted a society for experimentation in education and a journal devoted to psychology. He died in October 1911. Richard M. Wolf

See also **Graphology; Intelligence quotient.**

Bingham, George Caleb, *BIHNG uhm, jawrj KAY luhb* (1811-1879), was a leading American painter of *genre* subjects (scenes from everyday life). His paintings are known for their portrayal of different types of people in natural settings.

Bingham was born in Augusta County, Virginia, on March 20, 1811. His family moved to Franklin, Missouri, when he was 8 years old. In 1838, he went to Philadelphia to study art. Bingham then returned to Missouri and began a series of paintings of river life. His preparatory drawings for this series show that he was an excellent draftsman. He carefully organized his paintings using patterns that followed artistic principles. He died on July 7, 1879. Bingham's election scenes are remarkable studies of life in frontier towns. A detail of one of these paintings, *Stump Speaking,* appears in **United States, History of the.** Sarah E. Boehme

My Old Field Horse: Stable Scene (after 1850), an oil painting on canvas; St. Louis Art Museum

A George Caleb Bingham painting shows the artist's skill at painting everyday subjects in a realistic style.

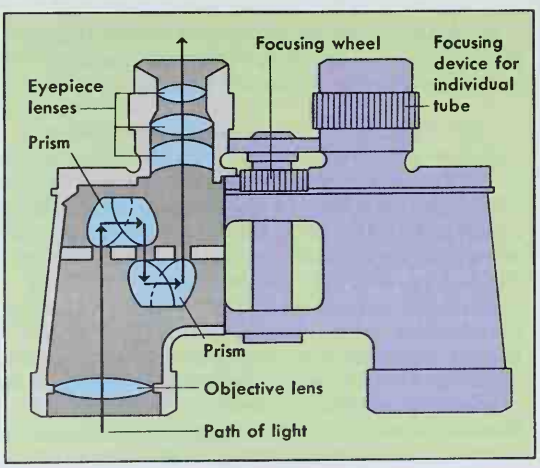
Binoculars are two identical telescopes joined side by side so that a viewer sees an enlarged image with both eyes at once. An *objective lens,* or *field lens,* at the front of each telescope gathers light from the object being viewed. This lens forms a magnified image that is upside down and reversed. In *prism binoculars,* the most common type of binoculars, prisms in each tube invert and reverse the image. In *field glasses,* a second lens in each tube performs this function. In both types of binoculars, light then travels through lenses in an *eyepiece.* These lenses magnify the image further, and the viewer sees a highly magnified, correctly positioned image through the eyepiece. Prism binoculars can provide more magnification and wider fields of view than can field glasses.

To focus, the viewer changes the space between the objective lens and the eyepiece in each tube. Most binoculars have two devices for changing this space: (1) a focusing wheel mounted between the tubes, and (2) a wheel mounted on one eyepiece. Turning the first wheel adjusts the distance in both tubes. Turning the second wheel changes the distance in only one tube to accommodate differences between the viewer's eyes.

Most binoculars are stamped with a code. In a code that reads *7 × 50,* for example, *7 ×* represents a magnifying power of seven times. The diameter of an image produced by binoculars with this power is seven times the diameter of the object being magnified. Most common binoculars have a magnification of 7 × or 8 ×.

The *50* in the code indicates the diameter, in millimeters, of the objective lens. For most viewing, 30- or 35-millimeter lenses are adequate. For viewing at night, a 50-millimeter lens is more suitable, because it gathers

Parts of binoculars WORLD BOOK diagram by Dick Keller



more light. Most binoculars are also stamped with a third number, which tells how wide an area can be seen from a distance of 1,000 yards (910 meters).

When choosing a pair of binoculars, make sure the telescopes are lined up correctly. After mounting the binoculars on a tripod, or steadying them against a wall, see if an object in the center of one telescope is in the center of the other. Also, see if an object near the edge of one field of view is about the same distance from the edge of the other field. David H. Levy

Binomial theorem is an important algebraic formula. A *binomial* is an expression that consists of two algebraic terms connected by either a plus sign or a minus sign. For example, $(a+b)$ is a binomial. The expression $(a+b)^n$ means that $(a+b)$ is to be *raised to the nth power* (multiplied repeatedly by itself for a total of n factors). This operation results in an expression called the *expansion* of the binomial. For example, the expansion of $(a+b)^2$ is $a^2+2ab+b^2$. The binomial theorem states a rule for writing the expansion of $(a+b)^n$ when n is any nonnegative whole number. The binomial theorem can be developed by observing patterns in expansions of $(a+b)^n$ as shown in the example below:

n	$(a+b)^n$
1	$a+b$
2	$a^2+2ab+b^2$
3	$a^3+3a^2b+3ab^2+b^3$

Each of the above expansions follows a certain pattern. (1) Each one has $(n+1)$ terms. (2) The first term is a^n and the last b^n. (3) The exponent of a decreases by 1 in each term and the exponent of b increases by 1. (4) The sum of the exponents of a and b in each term is n. (5) The coefficient of the first term is 1, of the second, $\frac{n}{1}$, of the third, $\frac{n(n-1)}{1\times 2}$, and so on. This pattern enables one to write the expansion in a general form called the binomial theorem as follows:

$$(a+b)^n=a^n+\frac{n}{1}a^{n-1}b+\frac{n(n-1)}{1\times 2}a^{n-2}b^2 + \frac{n(n-1)(n-2)}{1\times 2\times 3}a^{n-3}b^3+\ldots+b^n$$

In general, the letter r can be used to represent the power of b in the expansion. The formula for the term containing b^r can be written as follows:

$$\frac{n(n-1)(n-2)\ldots(n-r+1)}{1\times 2\times 3\ldots r}\,a^{n-r}b^r$$

The binomial theorem is used in the analysis of the binomial probability distribution. This distribution describes the possible outcomes of a certain experiment. The coefficients of the terms of the binomial theorem are the same as the elements of the *Pascal Triangle* (see **Permutations and combinations** [History]). Sir Isaac Newton discovered that if the exponent n is any number other than a whole number, the binomial theorem leads to an *infinite series* (see **Series**). Alan Shuchat

Biochemistry is the study of the chemical processes that take place in all living things. Biochemists conduct research into the molecules that occur in the cells of animals, plants, and other organisms. Many common elements, such as hydrogen, nitrogen, and oxygen, are found in chemical compounds in living things. Biochemists try to determine the structures of such compounds and to establish their biological functions.

All organisms contain compounds called *carbohydrates, lipids, nucleic acids,* and *proteins.* The molecules of these compounds help form the various structures in a cell and enable it to function properly. Some inorganic substances, such as minerals and water, also play a part in a cell's growth and maintenance.

Biochemical research covers a variety of processes. For example, biochemists conduct studies of large protein molecules called *enzymes,* which speed up chemical reactions in living matter. The enzymes of the human body promote chemical changes necessary for all functions, such as digestion and muscle contraction. Biochemists identify the enzyme molecules produced by cells and investigate the mechanism by which these molecules speed up chemical reactions. See **Enzyme.**

Other biochemical research involves chemical substances that help regulate *metabolism,* the process by which organisms use enzymes to transform food into energy and new tissue. Biochemists also study the *hormones* produced by various parts of an organism. Hormones are chemical substances that affect many body functions. Researchers hope to learn how these "chemical messengers" help regulate metabolism. See **Metabolism; Hormone.**

Biochemists seek to determine the precise role of a nucleic acid called *DNA* (deoxyribonucleic acid). Through the study of DNA, biochemistry has helped explain the molecular basis of the laws of genetics. Molecules of DNA are present in threadlike structures called *chromosomes* in the cell. These molecules carry hereditary data from one generation of cells to the next. Thus, organisms pass hereditary traits on to their offspring. Biochemists have used knowledge of DNA in genetic engineering to create new protein molecules and to begin to design new types of organisms. See **Cell** (The code of life); **Genetic engineering; Heredity.**

Other biochemical research has contributed to the understanding of *photosynthesis.* It has answered many questions about this complex process, in which green plants convert the radiant energy of the sun into the chemical energy of carbohydrates. See **Photosynthesis; Plant** (How plants grow).

Biochemical research has broadened knowledge in many other fields of biology, including biotechnology and medicine. The knowledge of enzymes, for example, helps physicians diagnose bone and liver diseases. Biochemistry has also contributed to the discovery of a number of antibiotics. In the future, biochemistry may provide a better understanding of why cancer develops and help scientists find more effective cures.

Research in biochemistry has also benefited agriculture. Farmers and agricultural researchers have used findings of biochemical research to develop crops of high quality and yield.

Investigative methods. Biochemists use a variety of scientific methods in their studies. They rely heavily on a technique called *chromatography* to separate and identify organic compounds (see **Chromatography**). This

method is especially useful for isolating *amino acids,* the compounds that make up proteins.

Electrophoresis is another method used to separate protein molecules for close study. It provides an effective way of analyzing the molecular structure of blood to detect sickle cell anemia and other genetic diseases. Electrophoresis is also used in DNA fingerprinting, a method of identifying people through analysis of their genetic material (see **DNA fingerprinting**).

Radioactive isotopes are often used to study the chemical reactions in organisms. Researchers "label" a molecule of a particular organic compound by substituting a radioactive isotope for one of its atoms. They trace the isotope through a chemical reaction, using devices that detect radioactivity. This technique has helped biochemists learn much about complex metabolic processes in animals and plants. Frederick B. Rudolph

See also **Chemistry; Molecular biology**

Additional resources

Goodsell, David S. *The Machinery of Life.* Springer-Verlag, 1993. *Our Molecular Nature.* 1996.

Hill, John W., Feigl, Dorothy M., and Baum, S. M. *Chemistry and Life: An Introduction to General, Organic, and Biological Chemistry.* 5th ed. Prentice Hall, 1997.

Biodegradable plastics. See **Plastics** (Plastics and the environment).

Biodiversity is the variety that exists among organisms and their environments. The term, short for *biological diversity,* is used mainly by scientists, conservationists, and others interested in the study, protection, and sustainable use of living things. Protecting biodiversity is one of the greatest challenges facing humankind. The scientists who specialize in ways to preserve it are called *conservation biologists.*

Kinds of biodiversity. Scientists usually distinguish three levels of biological diversity: (1) genetic diversity, (2) species diversity, and (3) ecosystem diversity.

Genetic diversity, the most basic level, refers to the variety of genes present in the members of a species.

Species diversity, the most familiar type of biodiversity, refers to the variety of species in a specific place or among a specific group of organisms. Most tropical environments have greater species diversity than cooler areas do. For example, the small tropical nation of Costa Rica has at least 830 species of birds, more than Canada and the mainland United States combined.

Ecosystem diversity refers to the variety of physical settings on earth, such as deserts, lakes, and coral reefs, and their populations of plants and animals. An *ecosystem* consists of the living things in a particular place and the nonliving things that are important to them. Every kind of ecosystem has a unique mix of species that differs from every other kind of ecosystem. The mix of plants and animals may differ even in rain forests on opposite sides of a mountain. If an ecosystem disappears, so do the species that live only in that ecosystem.

Protecting biodiversity. The earth has had several periods called *mass extinctions* when vast numbers of species died out. Our planet has now entered another era of mass extinction. In past extinctions, species became extinct from natural causes, such as volcanic eruptions or climate change. Today, human activities are mainly responsible for the loss of biodiversity. People have hunted species to extinction and destroyed habitats by logging and plowing. They have also introduced chemical pollutants and nonnative species that harmed native plants and animals. Conservation efforts, including laws to protect endangered species and programs to create national forests, have slowed but not stopped the loss of biodiversity.

There are many reasons why it is important to maintain biodiversity. Genetic diversity provides insurance against environmental changes. At any particular place or time, the genes in certain organisms make those individuals better adapted to their environment than other members of their species. A species with a rich variety of genetic traits is better equipped to cope with change because some of its individuals will have traits that enable them to adapt to new conditions.

Species diversity is important to save potentially useful organisms. Otherwise, sources of new drugs or food crops might be wiped out before they are discovered. Ecosystem diversity helps keep the earth livable. For example, forests absorb carbon dioxide from the atmosphere. If trees are destroyed, carbon dioxide builds up and contributes to a phenomenon called the *greenhouse effect.* Many scientists believe the greenhouse effect could bring permanent global warming and destroy many kinds of life. Biodiversity also should be maintained for its beauty. Each kind of species and ecosystem differs from every other and adds to the loveliness of our world. Elliot A. Norse

See **Conservation** with its list of *Related articles.* See also **Endangered species; Wildlife conservation.**

Biofeedback is a method of learning to control body processes that are not ordinarily thought of as being under voluntary control. People have learned to regulate their blood flow, blood pressure, body temperature, brain waves, heartbeat, and other internal body functions. Normally, the *autonomic* (self-regulating) part of the nervous system controls such processes automatically. People can also use biofeedback to relearn to use muscles no longer under their voluntary control because of an accident, stroke, or brain damage.

Oriental holy men had claimed for hundreds of years that they could consciously control their internal body functions. Western scientists traditionally scoffed at these claims. But by the late 1960's, biofeedback experiments had demonstrated that such control was possible. Since then, biofeedback has become an important method of medical therapy. Biofeedback research has led to a better understanding of certain diseases and the learning process. In the United States, most major cities have biofeedback clinics.

How biofeedback works. Biofeedback provides people with information on the functioning of the body processes they are learning to control. For example, people cannot normally detect a change in their blood pressure. Therefore, if they try to lower their blood pressure using only their conscious minds, they have no way of knowing whether or not they have succeeded. In learning to control this process through biofeedback, an individual is connected to a machine that measures the blood pressure on each heartbeat. If the pressure falls below a certain level, the machine sounds a tone. Subjects know they have succeeded when they hear the tone, and the knowledge of their success acts as a reward. This feedback of information makes biofeedback

training unique. With repeated practice, people can learn to regulate their blood pressure.

Biofeedback in medicine and psychology. Biofeedback is used to treat many illnesses. Heart patients can be trained to use biofeedback to control dangerously irregular heartbeats. Other patients use biofeedback to control high blood pressure, migraine and tension headaches, and muscle spasms. People also can learn to control stress by using biofeedback to regulate their own brain waves.

Physicians have long recognized that many body disorders are related to a person's emotional health. Such *psychosomatic* conditions include high blood pressure and bronchial asthma. Biofeedback research has helped explain how the state of a person's mind can influence the systems of the body.

Most psychologists once believed that the *visceral* (internal) organs could be taught new responses only through the simple kind of learning called *classical conditioning.* But biofeedback has shown that visceral responses can be taught by *instrumental conditioning,* a more advanced kind of learning. This development has stimulated further research into how human beings learn. For an explanation of classical and instrumental conditioning, see **Learning.** R. Craig Lefebvre

See also **Transcendental Meditation.**

Additional resources

Brown, Barbara B. *Infinite Well-Being.* Irvington, 1985.
Schwartz, Mark S., ed. *Biofeedback.* 2nd ed. Guilford, 1995.

Biogenesis, *BY oh JEHN uh sihs,* is a term in biology that is derived from two Greek words meaning *life* and *birth.* According to the theory of biogenesis, living things descend only from living things. They cannot develop spontaneously from nonliving materials. Until comparatively recent times, scientists believed that certain forms of life arose spontaneously from nonliving substances. By actual experimentation, the great French scientist Louis Pasteur disproved this false theory of spontaneous generation, also known as *abiogenesis.* Today, however, scientists are examining the theory that the first forms of life gradually came into being from lifeless matter millions of years ago.

The term *biogenesis* has also been used in reference to the *biogenetic* (or *recapitulation*) theory. This theory, which was popular during the late 1800's, stated that "ontogeny recapitulates phylogeny." This statement means that during its *ontogeny*—that is, during its development in the embryonic stage—each organism *recapitulates* (repeats) various stages in its species' *phylogeny* (evolutionary history). Scientists disproved this theory in the early 1900's. Lawrence C. Wit

See also **Life** (The origin of life); **Reproduction; Spontaneous generation.**

Biogeography. See **Geography** (Physical geography).

Biography is the story of a person's life written by someone else. The word *biography* comes from the Greek words *bios,* which means *a life,* and *graphein,* meaning *to write.* An *autobiography* is a person's story of his or her own life. See **Autobiography.**

Biographies help make the past more real and easier to understand because they tell about actual people and events. By reading biographies, people can satisfy their curiosity about well-known individuals and can experience historical events as though they were actually present.

A good biography presents the facts about a person's life. This information includes what the subject did and how the individual influenced the period in which he or she lived. A biography also should describe the subject's personality and provide an explanation for why he or she acted in certain ways.

Biographers help make their writings accurate by learning as much as possible about their subjects. Biographers use such research materials as diaries, personal letters, and autobiographies.

Most biographies are *interpretative*—that is, they not only present facts but also tell what they mean. A good biographical work should be objective and balanced, but these goals cannot always be achieved. For example, a biographer might not be able to write about all aspects of the subject's life. This situation may occur because of a lack of research material. Many individuals do not leave diaries or letters, or such materials may have been lost or destroyed.

Some biographers deliberately present a biased view of their subject. They may perform a "hatchet job" on a person by presenting only facts that portray him or her in an unflattering way. Other biographers may present only favorable information about the subject.

Forms of biography

There are five chief types of biography: (1) popular, (2) historical, (3) literary, (4) reference, and (5) fictional.

Popular biographies are perhaps the most common form of biography. They tell about the lives of such currently famous people as movie stars and sports figures.

Historical biographies deal with a wide variety of individuals and describe how they influenced past events. These works also tell what life was like during certain periods of history.

Literary biographies tell of the life and personality of an author, painter, or other kind of artist. Literary biographies also try to describe the talent and inspiration that enabled the subject to create great works.

Reference biographies, the simplest type of biography, are short accounts that mention only the major events of a person's life. Libraries have many books of reference biographies.

Fictional biographies combine features of a biography and of a novel. They are biographies because they are based on real people and events. They are novels because the author created conversations, background information, and other elements.

History

Early biographies. The first biographies were inscriptions on the tombs of rulers of ancient Assyria, Babylonia, and Egypt. These inscriptions merely glorified the individual, probably to increase his or her reputation both on the earth and with the gods.

Early biographies also appear in the Old Testament. These writings were *didactic*—that is, they taught a moral lesson. For example, the story of Ruth teaches loyalty, and the story of Joseph illustrates forgiveness.

The first true biographers came from ancient Greece and Rome. Plutarch, a Greek, wrote *Parallel Lives of Illustrious Greeks and Romans* about A.D. 100. These biogra-

phies were more objective than earlier ones. Plutarch sought to understand his subjects, not simply glorify them. He also achieved greater accuracy than previous biographers, though he accepted myths, legends, and hearsay as facts.

Two Roman writers, Tacitus and Suetonius, also used modern biographical techniques. Tacitus wrote *Agricola* (A.D. 98?), a biography of his father-in-law, a famous Roman general. This work is considered the first biography to deal effectively with both the career and personality of the subject. Suetonius' *Lives of the Caesars* (A.D. 121?) was popular because it included scandal as well as facts.

Jesus Christ inspired the Gospels of Matthew, Mark, Luke, and John, which were biographies written by early Christians. The Gospels were written for specific religious purposes, but they tell much about Jesus's life.

The Middle Ages. The church was the most important institution in the West during the Middle Ages, and biographies of that period reflect its influence. Writings about saints became the principal form of biography. These works, called *hagiographies,* rarely tell about the subject's career or personality. Instead, the writers chose certain events in a saint's life to give Christians an example of pious living. Hagiographies had a standard form and told of such acts by the saint as the performance of miracles and the conversion of nonbelievers.

During the 1300's, an intellectual movement called *humanism* began. Humanism emphasized the importance, dignity, and achievements of human beings, particularly of individual people. The Italian writers Petrarch and Giovanni Boccaccio expressed the humanist concept in their works. Petrarch told about famous Romans in his unfinished *Lives of Famous Men.* Boccaccio wrote *Life of Dante* (1355), a biography of the famous poet.

Both Petrarch and Boccaccio were somewhat uncritical about their facts. They also tended to glorify their subjects as did the hagiographers. However, their works show that curiosity about the subject was an important element in biographical writing.

The Renaissance. The changes in biography started by Petrarch and Boccaccio spread rapidly through Europe during the Renaissance. Scholars were inspired by the writings of such classical authors as Plutarch and Suetonius, and used their works as models.

Renaissance biographers concentrated on the personalities of their subjects. The emphasis in biographies also shifted from religious subjects to such *secular* (nonreligious) people as rulers and military leaders. Giorgio Vasari, an Italian, described each of his subjects as a person in *Lives of the Most Eminent Painters, Sculptors, and Architects* (1550). Pierre Matthieu of France wrote *Histoire des derniers troubles de France* (1694-1695), a work containing many biographical pieces that reflected the influence of Plutarch and Suetonius.

John Foxe of England, in *The Book of Martyrs* (1563), described the lives of Protestant martyrs. These biographies focused more attention on their subjects as human beings than had the hagiographies of the Middle Ages. Other English biographers included Saint Thomas More, author of *The History of King Richard III,* which was written about 1513; and William Roper, who wrote about More. Several authors contributed to a series of biographies, most of them about royalty, called *A Mirror for Magistrates* (1559-1610).

The 1600's. The trends begun by Renaissance biographers were continued by many writers of the 1600's. These authors also strove for honesty and accuracy in their works. Izaak Walton of England wrote biographies of five prominent English clergymen, poets, and statesmen. Walton did extensive research on his subjects and had great respect for accuracy. However, he did not tell all the personal details of their lives. Walton's interest in the personalities and careers of his subjects, together with his own literary style, gave his works an almost modern quality.

John Aubrey, another English author, believed personal matters in a subject's life belonged in a biography. Aubrey wrote *Brief Lives* between 1669 and 1696, but it was not published until 1813. This work includes personal details of the subjects' lives and reflects Aubrey's interest in their unusual traits. However, he did not always distinguish between gossip and fact.

The 1700's were a great age of biography. Writers produced scholarly, readable biographical works by combining literary skill and historical accuracy. Public interest in martyrs and saints diminished, and biographers focused on secular subjects. They used a variety of research materials; checked facts carefully; and avoided hearsay, legends, and myths. Pierre Bayle of France, author of the *Historical and Critical Dictionary* (1697), called for a scientific approach to biographical research.

During the 1700's, the novel became an important form of literature. Biographers, influenced by the skills of novelists, paid more attention to literary style. Horace Walpole, an English author, wrote in a witty, entertaining style that served as an example for other writers.

Samuel Johnson of England was one of the greatest biographers of his time and also the subject of one of the finest biographies ever written. Johnson wrote *The Life of Mr. Richard Savage* (1744) and *The Lives of the English Poets* (1779-1781). He became known for his concern for the truth and his understanding of his subjects.

Johnson is best remembered, however, as the subject of James Boswell's *The Life of Samuel Johnson* (1791). Many scholars consider Boswell's work the greatest biography of all time. Boswell had known Johnson for many years and combined his own observations of the man with those of others. He was thus able to add a psychological element to his study—to explain how and why Johnson thought and acted as he did. Boswell also used information from documents and letters. His research was so thorough that scholars have found few errors in Boswell's biography of Johnson.

The 1800's. Boswell's style influenced many biographers of the 1800's, but they did not achieve his psychological insight. Some scholars wrote biographies that included numerous details of a person's life. However, these writers did not give balanced accounts because they presented only the respectable side of their subjects. As a result, many biographies of the 1800's were dull and incomplete accounts.

Some biographers, however, offered a balanced picture of their subjects. One was Thomas Carlyle, a Scottish historian who wrote the biography of the English statesman Oliver Cromwell. Carlyle objected to biographies that did not completely cover the subject's character. Thomas Babington Macaulay, an English historian, followed Carlyle's approach. Macaulay's *The History of*

England from the Accession of James II (1848-1861) presents his subjects completely in a witty, forceful style and with a minimum of words.

Works by many American biographers of the 1800's resembled those of English writers. Biographers of Revolutionary War heroes attempted to create a spirit of nationalism, and their works became especially popular. These authors' works also presented only the respectable side of their subjects. For example, Mason Locke Weems presented stories in his *The Life and Memorable Actions of George Washington* (1800-1806) that made Washington appear faultless. Jared Sparks, another American biographer, actually changed the wording of Washington's letters to make him appear more learned and well bred.

Modern biography. James Anthony Froude, an English historian, became one of the first biographers to present both the favorable and unfavorable sides of a subject. His *Thomas Carlyle* (1882-1884) set forth details of Carlyle's personal life that shocked many of the book's readers.

The traditional biographical form was also challenged in the early 1900's by the new science of psychology. The theories of Sigmund Freud, an Austrian physician, were especially influential. Freud believed that many of a person's actions resulted from unconscious motivation—that is, from reasons unknown even to the individual. Freud developed the *psychoanalytic theory* to help uncover these unconscious motives (see **Psychoanalysis**). Freud was one of the first people to use the psychoanalytic theory in writing a biography. In *Leonardo da Vinci* (1910), he used it to explain the personality of the famous artist of the Italian Renaissance. By the 1920's, the use of psychoanalytic theory had become a fad among biographers. But most of them had little understanding of it.

About 1900, biographers also began to write more popular and lively works. Hilaire Belloc, a British author, enlivened his *Danton* (1899) and *Marie Antoinette* (1909) by inventing details of the subjects' lives. André Maurois of France and Emil Ludwig of Germany wrote fictional biographies in which they used real people but invented most or all of the dialogue.

Authors started to develop a more scholarly form of biography after World War I ended in 1918. Several works by American writers, including Carl Sandburg's *Abraham Lincoln* (1926-1939) and Douglas Southall Freeman's *R. E. Lee* (1934-1935), were both readable and thoroughly researched. Groups of authors contributed large numbers of biographies for such works as *The Dictionary of National Biography* (1885-) and the *Dictionary of American Biography* (1928-).

Books called *debunking biographies* also became popular after World War I. These works deliberately undermined the reputation of great heroes. Lytton Strachey of England wrote *Eminent Victorians* (1918), which portrayed several English heroes of the 1800's as less than perfect. In the United States, authors of debunking biographies wrote about such national heroes as George Washington and Abraham Lincoln.

Biography today

Many of today's biographies tell about the lives of people of the mid-1900's and of contemporary figures. For example, several authors have written biographies of President John F. Kennedy and of members of his family. More biographies than ever before are written of individuals who are still alive. Biographies of historic figures also have a wide audience. They include such analytical works as *Mary, Queen of Scots* (1969) by Antonia Fraser of Britain and *Samuel Johnson* (1977) by W. Jackson Bate of the United States.

Two problems have challenged biographers for years. First, a biographer must decide how much to tell about a subject's life. Many potential subjects of a biography may leave so much material that a writer has difficulty deciding what to include. As a result, many biographers write extremely long works with so many details that the subject's character is unclear.

A second problem, the development of the subject's character, occurs even if biographers choose details wisely. Few biographers are able to observe their subject directly. In addition, human behavior is so complex that an author cannot rely on direct observation. Some writers use psychological theories to help them understand their subjects. Today's authors have a better knowledge of these theories and use them more carefully than did earlier biographers. Biographies that reflect good use of psychological theories include *Henry James* (5 volumes, 1953-1974) by Leon Edel of the United States, *Hitler* (1973) by Joachim C. Fest of Germany, and *Thomas Jefferson: An Intimate History* (1974) by Fawn M. Brodie of the United States.

Erling A. Erickson

Related articles in *World Book* include those on the following biographers:

Boswell, James	Maurois, André	Strachey, Lytton
Carlyle, Thomas	More, Saint Thomas	Suetonius
Freeman, Douglas Southall	Nevins, Allan	Tacitus, Cornelius
Jones, Ernest	Plutarch	Walton, Izaak
Macaulay, Thomas B.	Sandburg, Carl	Weems, Mason Locke
	Sparks, Jared	Zweig, Stefan

Additional resources

Whittemore, Reed. *Pure Lives: The Early Biographers.* Johns Hopkins, 1988. *Whole Lives: Shapers of Modern Biography.* 1989.
Salwak, Dale, ed. *The Literary Biography.* Univ. of Ia. Pr., 1996.
Schwarz, Ted. *The Complete Guide to Writing Biographies.* Writer's Digest, 1990.

Biological clock refers to a timing mechanism that operates in living things. Biological clocks control the rhythms of functions and processes in organisms. They keep accurate time during each 24 hours and over days, weeks, months, and even years. Biological clocks keep the activities of living things in harmony with regular changes in the surroundings.

Birds migrate, fish spawn, and flowers blossom on schedules that are set by their built-in clocks. In human beings, biological clocks time periods of sleep and wakefulness and of body activities. The science that deals with the study of biological clocks and rhythms is called *chronobiology.*

No one is certain where biological clocks are located or how they work. Experiments indicate every living thing inherits timing mechanisms. Most scientists believe biological clocks occur in several forms and regulate processes in such simple structures as cells, as well as complex organs and organ systems. Research indicates that the pineal gland and the hypothalamus in the brain may be the master clocks in animals.

Importance of biological clocks

Biological clocks keep track of cyclic variations in the environment, including day and night, movements of the ocean tides, phases of the moon, and seasons of the year. Most, if not all, living things have internal cycles—called *biological rhythms*—that are controlled by biological clocks. The biological rhythms of each particular species are timed to enable the organism to efficiently meet the demands of its environment. Biological rhythms continue on schedule even in laboratories where the organism is shielded from all evidence of passing time and of outside change. But the rhythms can be shifted—and the biological clock reset—by changing the time at which the organism gets light or by changing other critical time cues from the environment.

Daily rhythms. Many biological rhythms are based on a day-night cycle. They are called *circadian rhythms* because they occur about every 24 hours. *Circadian* comes from Latin words that mean *about a day.* For most living things, the day-night cycle is broken into periods of activity and periods of rest. But these periods do not occur at the same time of day for all living things. Human beings are most active during the day and rest at night. Apes, bees, butterflies, monkeys, and many other kinds of animals also follow this schedule. On the other hand, bats, cats, moths, owls, rats, and others are active at night. The genetically inherited traits of biological clocks in each species set the schedule.

Plants also show daily rhythms. For example, they raise their leaves in the day and lower them at night. These rhythmic changes, called *sleep movements,* continue even when the plants are kept in caves or in other places where light and temperature do not change.

Other rhythms. Fiddler crabs and other seashore animals show complex rhythms. The skin of fiddler crabs normally darkens at dawn and gets pale at dusk. Their running activity adjusts to the tides, which rise and fall about 50 minutes later each day. Fiddler crabs kept in constant darkness in laboratories continue to change color rhythmically, as if responding to the tides of their home beach. But when moved to a beach that has different tidal times, they adjust activities to the new tides. Their biological clocks have been automatically reset.

Many living things, including the grunion, a small fish found along the California coast, have monthly or semimonthly breeding rhythms. From February to September at maximum high tide, every 14.8 days, grunions ride a wave to shore. The wave recedes, the females drop their eggs in the wet sand, and the males fertilize the eggs. The next wave carries the grunions back into the ocean, but the eggs remain on the beach. At the next high tide—14.8 days later—a wave comes in, breaks the eggs, and carries the young fish out to sea.

Biological clocks set the schedules for yearly rhythms in living things. They control the sprouting of seeds and the hibernation and migration of birds and other animals. These clocks also seem important in helping birds, fishes, crustaceans, and insects to navigate. The clocks, used in conjunction with the sun, moon, and stars, help them to correct continuously for the earth's rotation, and stay on the proper course. Biological clocks also coordinate breeding cycles in animals to seasonal changes in the amount of daylight. Some species of animals mate in the fall, when the period of darkness exceeds the period of light. Other species breed in the spring, when the period of light is greater than that of darkness.

Biological clocks in people

Biological clocks in people work on schedules essential to life and health. Human beings have daily, weekly, monthly, and seasonal biological rhythms. The level of hormones and other chemicals in the blood varies greatly over each of these time periods. Most vital body processes have a circadian rhythm. Activities of the cells, glands, and organ systems are coordinated with one another and with the day-night rhythm of the environment.

The rate at which the body processes work varies rhythmically throughout the day and night. For example, in most people who are active during the daytime, body temperature varies about three degrees during a 24-hour period. The temperature is lowest during sleep and greatest during the afternoon and early evening.

The symptoms or occurrence of many diseases follows biological rhythms. For example, cerebral hemorrhages are most common late in the evening. Most heart attacks occur in the morning. Most people who suffer from asthma feel worse in the evening and overnight. The study of influences that biological rhythms have on human diseases is called *chronopathology.*

Biological rhythms also influence the effects medications have on illnesses. Many medications, such as those used to treat allergies, arthritis, cancer, and heart disease, are strongly affected by circadian rhythms. The branch of chronobiology that deals with the study of biological rhythms and medications is called *chronopharmacology.* Greater knowledge of biological rhythms in the treatment of diseases could result in major changes in the practice of medicine. Michael H. Smolensky

See also **Phenology; Pineal gland.**

Biological diversity. See Biodiversity.

Biological science. See Science (The life sciences).

Biological warfare. See Chemical-biological-radiological warfare.

Biological Weapons Convention is an international treaty designed to prevent the production and use of biological agents to spread disease among people. The use of such agents as weapons is called *germ warfare.*

The treaty is officially called the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction. It took effect in 1975. By 2000, more than 140 nations had *ratified* (approved) the treaty. It prohibits countries from possessing large amounts of biological agents or *toxins* (poisons), and the weapons systems to deliver them. Nations also may not trade biological weapons or help other countries develop them.

Both the United States and the Soviet Union conducted experiments to produce biological weapons during the Cold War, a period of hostility between those countries after World War II (1939-1945). Both nations ratified the Biological Weapons Convention in the 1970's.

The treaty does not provide for means of verification or enforcement. Nations merely agree to abide by it in good faith. By the early 2000's, several governments and other groups were working to create methods of inspection and verification. William B. Vogele

See also **Chemical-biological-radiological warfare.**

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Producing an experimental vaccine

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Tagging a bear cub for study in the wild

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Developing new plant varieties

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Photographing a file clam

The work of biologists includes a wide range of activities and takes place in many different settings. For example, some biologists work outdoors, studying wildlife in the forests or the ocean. Others carry on laboratory research in such areas as plant breeding or the production of drugs.

Biology

Biology is the scientific study of living things. There are more than 10 million species of living things on the earth. They range in size from microscopic bacteria to huge blue whales and towering redwood trees. Living things also differ greatly in where and how they live. However, all forms of life share certain characteristics that set them apart from nonliving things. These characteristics include the ability to reproduce, to grow, and to respond to changes in the environment.

Traditionally, biology has been divided into two major fields. *Botany* deals with plants, and *zoology* with animals. Botany and zoology are further divided into various branches and specialized areas of study. But most branches of biology—for example, *anatomy* (the study of the structure of living things) and *genetics* (the study of heredity)—apply to both plants and animals.

Biology may also be divided into *ecology, physiology,* and *systematics.* Ecology deals with the relationships among living things and between organisms and their environment. Physiology concerns life functions, such as digestion and respiration. Systematics, also called *taxonomy,* is the scientific classification of organisms.

Biologists often make use of the methods and findings of other sciences. For instance, they rely on physics and chemistry to help them understand the processes that occur in living plants and animals. They use statistics in studying changes in the size of an animal or plant *population*—that is, the number of organisms of a particular species in an area. *Exobiologists* work with astronomers in searching for life elsewhere in the universe.

Biological research has greatly affected people's lives. For example, farm production has soared as biologists have helped develop better varieties of plants and new agricultural techniques. Discoveries in biology have enabled physicians to prevent, treat, or cure many diseases. Research on the relationships between living things and their environment has helped in the management of wildlife and other natural resources.

Garland E. Allen, the contributor of this article, is Professor of Biology at Washington University and coauthor of The Study of Biology.

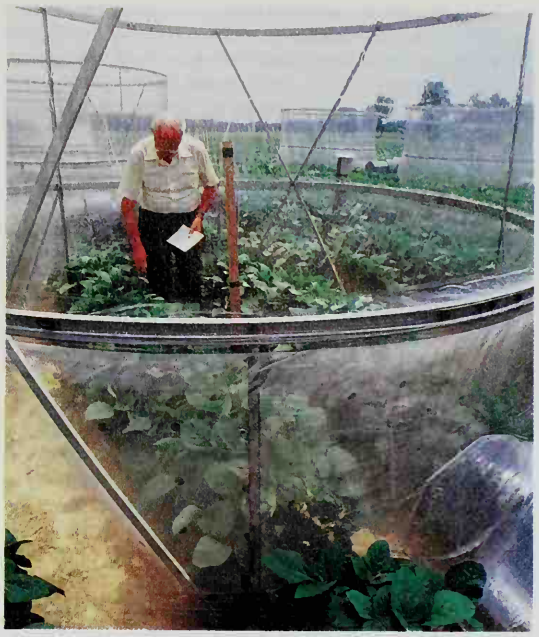
What biologists study

Biology is such a broad subject that most biologists specialize in some area of study. But in whatever area

they work, all biologists are interested in both the parts of living things and how the parts work together.

Certain biologists study organisms that live in a specific environment. *Marine biologists,* for example, investigate life in the ocean. Some biologists concentrate on a particular type of organism. *Ornithologists,* for instance, study birds. Many biologists examine the parts of living things. *Cytologists,* for example, deal with the structure, composition, and functions of cells. Other biologists analyze life processes. *Embryologists,* for example, investigate the formation and development of animals and plants before they become independent organisms.

The techniques and tools that biologists use depend on what they are investigating. Many biologists conduct experiments to gain information and to develop and test theories. Their experiments may involve making a change in an organism's way of life or its environment and then observing the effects of that change. For example, a biologist may change the diet of an animal and study how the animal's growth and functioning are thereby affected. The microscope has long been one of the biologist's most useful tools. An entire branch of biology, called *microbiology,* is devoted to the study of organisms that can be seen only with a microscope. Other techniques and tools used by biologists range from aerial surveys of plant and animal populations to techniques that isolate the molecules of living cells.



© Runk/Schoenberger from Grant Heilman

An ecologist inspects soybean plants that have been exposed to various pollutants in a specially designed tent. Many ecologists study the effects of pollution on plant and animal life.

History of biology

Beginnings. In prehistoric times, people gradually developed a great deal of practical biological knowledge. They learned to grow many kinds of plants and to tame and raise certain animals. In ancient times, people of China, India, and the Middle East accumulated further knowledge of plants and animals. For instance, they knew how to use numerous plants as medicines or poisons. The Egyptians learned some anatomy and physiology through embalming their dead.

The ancient Greeks made major advances in biology. Unlike most other people of the time, some Greek thinkers did not believe that gods or spirits caused natural events. Instead, they saw nature as operating according to laws that people could discover. About 400 B.C., a Greek physician named Hippocrates taught that diseases have only natural causes. He also emphasized the relationships among the parts of an organism and between an organism and its environment. Hippocrates is often called the father of modern medicine.

During the 300's B.C., the Greek philosopher Aristotle gathered a vast amount of information about plants and animals. He was one of the first thinkers to classify ani-

Major fields of biology

Anatomy deals with the structure of living things.
Bacteriology is the study of bacteria.
Biochemistry examines the chemical processes and substances that occur in living things.
Biophysics applies the tools and techniques of physics to the study of living things.
Botany is the study of plants.
Cryobiology, *KRY oh by AHL uh jee,* analyzes how extremely low temperatures affect living things.
Cytology, *sy TAHL uh jee,* studies the structure, composition, and functions of cells.
Ecology concerns the relationships living things have with one another and their environment.
Embryology deals with the formation and development of plants and animals from fertilization until they become independent organisms.
Entomology, *EHN tuh MAHL uh jee,* is the study of insects.
Ethology, *ih THAHL uh jee,* concerns animal behavior under natural conditions.
Evolutionary biology is the study of the evidence supporting the theory of evolution.
Genetics is the study of heredity.
Ichthyology, *IHK thee AHL uh jee,* is the study of fishes.
Immunology concerns the body's defenses against disease and foreign substances.
Limnology, *lihm NAHL uh jee,* studies bodies of fresh water and the organisms that live in them.
Marine biology investigates life in the ocean.
Medicine is the science and art of treating and healing.
Microbiology deals with microscopic organisms.
Molecular biology analyzes molecular processes in cells.
Neurobiology deals with the nervous system of animals.
Ornithology, *AWR nuh THAHL uh jee,* is the study of birds.
Paleontology, *PAY lee ahn TAHL uh jee,* is the study of prehistoric life.
Pathology examines the changes in the body that can cause disease or are caused by disease.
Physiology deals with the functions of living things.
Sociobiology focuses on the biological basis for social behavior in human beings and other animals.
Systematics, also called *taxonomy,* is the scientific classification of organisms.
Virology, *vy RAHL uh jee,* concerns viruses and virus diseases.
Zoology, *zoh AHL uh jee,* is the study of animals.

mals according to their own characteristics rather than according to their usefulness to people. Pliny the Elder, a Roman naturalist who lived during the first 100 years after Christ's birth, also collected many facts about plants and animals. He included the information in his 37-volume *Natural History.*

During the A.D. 100's, Galen, a Greek physician who practiced medicine in Rome, contributed greatly to advances in anatomy and physiology. He gained much of his knowledge from treating injured gladiators and dissecting apes and pigs.

The growth of biological knowledge slowed during the Middle Ages, a 1,000-year period in European history that began in the 400's. However, works by Hippocrates, Aristotle, Galen, and other ancient authorities were collected, preserved, and translated by Arab scholars in the Middle East. The Arabs also made major contributions of their own in biology. The works of the ancient Greek and Arab scientists eventually made their way to Europe. During the Middle Ages, the authority of the ancient writers was unquestioned, though their works contained many errors.

The Renaissance. From the early 1300's to about 1600, a new spirit of inquiry spread across western Europe. During this period, called the Renaissance, many anatomists and physiologists began to challenge the authority of the ancient writers. They believed that people should rely on experimentation and observation rather than accept without question the ideas of the ancients.

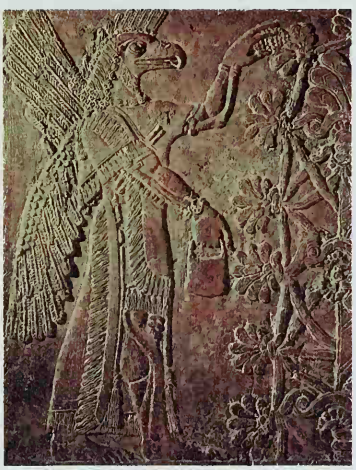
The emphasis on observation stimulated the development of a high degree of naturalism and accuracy in biological illustration. During the late 1400's and early 1500's, the great Italian artist Leonardo da Vinci made hundreds of drawings of the human body in which he paid careful attention to detail and proportion. Leonardo based his work on dissections of human corpses. The first scientific textbook on human anatomy was published in 1543. This work, titled *On the Fabric of the Human Body,* was written by Andreas Vesalius, an anatomist born in what is now Belgium. Like Leonardo, Vesalius based his work on dissections he had made of human corpses. The book, richly illustrated with exceptionally lifelike drawings of human anatomy, corrected many of Galen's mistaken ideas.

One of the most important discoveries in physiology in the 1600's was made by William Harvey, an English physician. In 1628, Harvey published the results of his experiments showing how blood, pumped by the heart, circulates through the body.

Early discoveries with the microscope. The introduction of the microscope led to great discoveries in biology during the middle and late 1600's. About 1660, an Italian anatomist named Marcello Malpighi, with the aid of a microscope, became the first person to observe the movement of blood through the capillaries. In 1665, Robert Hooke, an English experimental scientist, published *Micrographia,* a book containing detailed drawings of many biological specimens as seen with a microscope. The book included the first drawings of cells. In the mid-1670's, Anton van Leeuwenhoek, a Dutch amateur scientist, discovered microscopic life forms, thus opening up a new world for investigation.

The origins of scientific classification. During the 1700's, Europeans came into increasing contact with distant parts of the world and thereby learned of many unfamiliar plants and animals. Naturalists realized that they needed a classification system that could include those plants and animals. In 1735, the Swedish naturalist Carolus Linnaeus (also called Karl von Linné) published a system of classification in which he grouped organisms according to structural similarities. His system forms the basis of scientific classification used today.

Classifying organisms according to structural similarities stimulated interest in *comparative anatomy*—the comparison of the anatomical structures of different organisms. The leading comparative anatomist of the late 1700's and early 1800's was Baron Cuvier of France. Cuvier noticed that most kinds of animals have one or



SCALA/Art Resource

The cultivation of a date palm is shown in this ancient Mesopotamian carving. Much early biological knowledge dealt with farming.

S. Champier, *Symphonia Platonis,* 1516

Dissections of animals were carried out by the Greek physician Galen during the A.D. 100's. Galen's studies greatly advanced the knowledge of anatomy.

Metropolitan Museum of Art, Rogers Fund, 1913

A recipe for cough syrup made from plants appears in an Arabic manuscript from the 1220's. The Arabs made major contributions in botany and medicine.

another of a very few basic body types. He devised a system of classifying animals according to basic body types that is still used in modified form. Cuvier also applied the methods of comparative anatomy to another field he helped establish, *paleontology*—the study of prehistoric life.

The theory of evolution. Most biologists had long believed that each species of life had remained unchanged and no new species had appeared since the world began. However, biologists began to question those beliefs during the late 1700's. They noted that farmers had produced new varieties of plants and animals by selective breeding. In addition, voyages of exploration had revealed isolated groups of plants and animals that contained many species which varied only slightly from one another. Biologists wondered why there should be so many species with little variation. Such observations led many biologists to believe that species change over time and that some species had *evolved* (gradually developed) from others.

During the early 1800's, several biologists proposed explanations of how species evolve. The most convincing theory was eventually reached independently by two British naturalists—Charles Darwin and Alfred Russel Wallace. However, Darwin presented his ideas in a widely read book, and his work became better known.

Darwin detailed his theory of evolution in *The Origin of Species* (1859). According to Darwin, some organisms are born with traits that help them survive and reproduce. They pass the favorable traits on to their offspring. Other members of the same species that have unfavorable traits are less likely to survive and reproduce. The unfavorable traits eventually die out. Darwin proposed that species evolve as more and more favorable traits appear and are passed from generation to generation. He called the process *natural selection*.

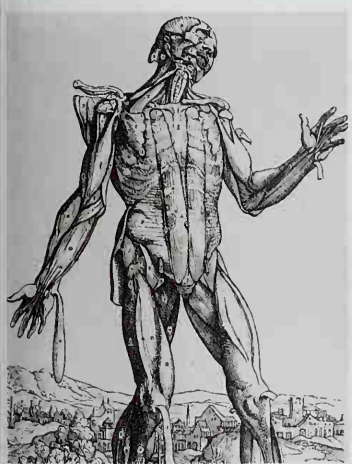
Materialistic physiology and the cell theory. Many physiologists of the late 1700's had come to think of life as the total of the physical and chemical processes occurring in an organism. Unlike some other biologists, they did not believe that living things are guided in their functioning by any spiritual or supernatural forces. Instead, they felt that living things are nothing more than special combinations of materials and function like machines. Such views are called *materialistic physiology* or *mechanistic materialist physiology*.

Antoine Lavoisier, a French chemist, applied the techniques of chemistry to physiology in the late 1700's. He compared respiration to the burning of a candle because both processes use oxygen and produce heat and carbon dioxide. Beginning in the mid-1800's, the French physiologist Claude Bernard introduced a new approach to materialistic physiology. He saw living things as highly organized sets of control mechanisms that work to maintain the internal conditions necessary for life. He pointed out that in a mammal, for example, such mechanisms keep body temperature constant in spite of variations in the temperature outside the organism.

Paralleling developments in physiology was a growing understanding of the cell. In the late 1830's, two Germans—the botanist Matthias Schleiden and the physiologist Theodor Schwann—proposed that the cell was the basic structural and functional unit of all plants and animals. In 1858, Rudolf Virchow, another German scientist, published his theory that all diseases were diseases of the cell. In combination, these ideas are called the *cell theory*.

Building on materialistic physiology and the cell theory, Louis Pasteur, a French chemist, and Robert Koch, a German physician, firmly established a new theory of disease during the middle and late 1800's. Through their studies, Pasteur and Koch proved what was called the germ theory. According to the theory, many diseases are caused by microscopic organisms.

The growth of modern biology. During the late 1800's, Darwin's theory of evolution had stimulated much speculation among biologists about the origin, nature, and development of organisms. By the early



The human muscular system is shown in this illustration from Andreas Vesalius' *On the Fabric of the Human Body* (1543), the first scientific text on human anatomy.

Dr. Jeremy Burgess, Science Photo Library

A detailed drawing of a fly was published in *Micrographia* (1665) by Robert Hooke of England. Hooke pioneered in studying specimens with the microscope.

Drawing by U. Schleicher-Benz in "Lindauer Bilderbogen", © Jan Thorbeck Verlag, Sigmaringen, Germany

A flower "clock" proposed by the Swedish naturalist Carolus Linnaeus in 1745 arranges species by the times of the opening and closing of the blooms.

1900's, however, many biologists strongly rejected the emphasis on theory and speculation. Instead, they stressed the value of carefully controlled experiments and the application of mathematical techniques to biology. That method helped lead to an enormous expansion of biological knowledge, particularly in the understanding of the chemical and molecular basis of life.

Genetics was established as a branch of biology in the early 1900's. It developed chiefly from experiments conducted during the mid-1800's by Gregor Mendel, an Austrian monk. On the basis of his experiments, Mendel discovered that physical characteristics are produced by basic hereditary units that transmit traits from generation to generation. About 1910, Thomas Hunt Morgan, an American biologist, found that Mendel's hereditary units—later called *genes*—are located on structures called *chromosomes* within cells. Biologists at the time also noted that changes in hereditary traits correspond to visible changes in chromosome structure.

During the 1940's, geneticists found that genes guide the manufacture of the proteins by which cells regulate their chemical processes. In 1953, biologists James D. Watson of the United States and Francis H. C. Crick of Britain proposed a model of the molecular structure of *deoxyribonucleic acid* (DNA), the material in chromosomes that controls heredity. Knowing DNA structure enabled biologists to understand the molecular basis of such life processes as heredity and genetic change.

Breakthroughs in genetics helped alter biologists' approach to the study of evolution. By the 1960's, many biologists were studying evolution in terms of changes in the kinds and numbers of genes in a population.

The field of ecology began to develop dramatically in the early 1900's. Scientists had long recognized the importance of the relationships among organisms and between organisms and their environment. But the development of ecology as a separate branch of biology occurred after the introduction of such techniques as statistical analysis of complex systems of relationships. Since the 1960's, concern about environmental effects of pollution has greatly stimulated research in ecology.

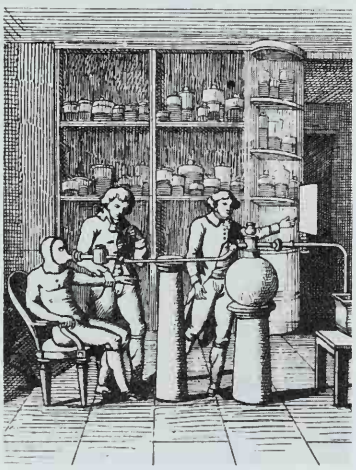
During the 1900's, *neurobiologists*—people who study the nervous system—have learned much about how nerve cells and nerve networks function. Their work has led to a better understanding of how the brain and central nervous system process information.

Current research and issues. The study of the human *immune system*—that is, the body's defense system against disease and foreign substances—is one area at the frontier of biological research. Scientists are learning how our bodies produce a seemingly endless variety of disease-fighting proteins called *antibodies*. Each antibody is tailored to combat one of many foreign substances called *antigens*. Biologists have discovered that the body can produce a great number of different antibodies because certain genes rearrange themselves to produce antibodies that attack specific antigens. The study of the immune system has helped combat AIDS, a disease that immobilizes the immune system.

Since the 1950's, biologists have been collecting evidence for the theory that life began in a series of chemical reactions early in the earth's history. They have produced biological molecules in chemical experiments that reproduce conditions thought to have existed on earth billions of years ago. See **Life** (The origin of life).

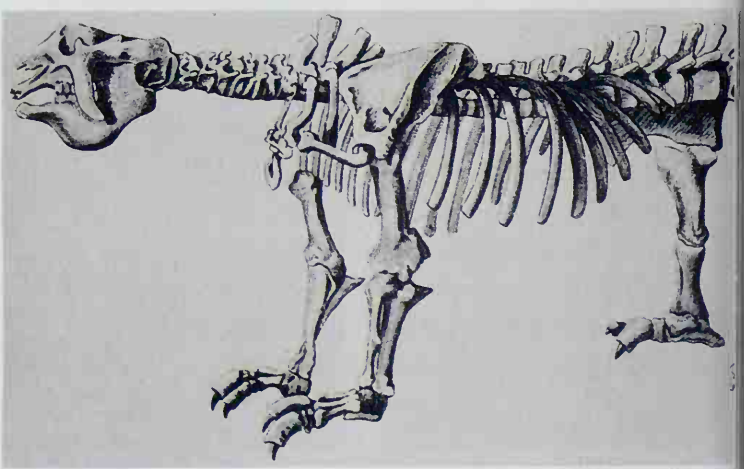
Since the 1970's, a growing number of biologists have questioned the idea that evolutionary change occurs only as a result of a gradual process. Instead, they accept the idea that evolution may proceed at times by abrupt changes leading to the replacement of one species by another. Although there is questioning over details, most biologists believe in the general outlines of evolution theory. However, some other people reject the theory because of the many gaps in our understanding of how particular species evolved. Still others object to the idea of evolution because it conflicts with their religious beliefs about the creation of life. See **Evolution**.

By the mid-1970's, scientists had learned how to re-



Bettmann Archive

An experiment on respiration is shown in this engraving of Antoine Lavoisier's lab. The Frenchman studied physiological processes in the late 1700's.



From Cuvier's *Studies on the Bones of Fossil Vertebrates*, 1812

The skeleton of an extinct giant sloth was drawn by Baron Cuvier of France, the leading comparative anatomist of the late 1700's and early 1800's. Cuvier pioneered in *paleontology*, the study of prehistoric life. He used the methods of comparative anatomy to determine the structures of prehistoric animals from their fossil remains.

Important dates in biology

c. 400 B.C. Hippocrates established the principles of modern medicine, teaching that diseases have only natural causes.
A.D. 100's Galen advanced anatomy and physiology through treating injured gladiators and dissecting apes and pigs.
1543 Andreas Vesalius's *On the Fabric of the Human Body,* the first scientific text on human anatomy, was published.
1628 William Harvey published his discovery of how blood circulates through the body.
1665 The first drawings of cells appeared in Robert Hooke's book *Micrographia.*
Mid-1670's Anton van Leeuwenhoek discovered microscopic forms of life.
1735 Carolus Linnaeus classified organisms according to their structural similarities, laying the foundation for modern scientific classification.
Late 1700's Antoine Lavoisier conducted chemical studies of respiration and other physiological processes.
c. 1800 Baron Cuvier made major contributions in *comparative anatomy* (the comparison of the structures of different species) and *paleontology* (the study of prehistoric life).
1838-1839 Matthias Schleiden and Theodor Schwann proposed that the cell is the basic unit of life.
Mid-1800's Gregor Mendel discovered basic laws of heredity.
1859 Charles Darwin set forth his theory of evolution in *The Origin of Species.*
Middle and late 1800's Louis Pasteur and Robert Koch firmly established the germ theory of disease.
1953 James D. Watson and Francis H. C. Crick proposed a model of the molecular structure of *deoxyribonucleic acid* (DNA), the hereditary material in chromosomes.
Late 1970's Researchers used genetically engineered bacteria to produce *insulin,* a hormone for treating diabetes.
1996 Scientists led by Ian Wilmut achieved the first successful cloning of a mammal from the cells of an adult animal. They produced a clone of a sheep.
2000 The Human Genome Project and Celera Genomics Corporation, a private firm, announced that together they had sequenced essentially the entire human genome.

move genes from one species and insert them into another. The process is called *genetic engineering.* Genetic engineering offers many potential benefits in medicine, industry, and agriculture. For example, scientists have transferred to bacteria the human gene that produces *insulin*—a hormone that regulates the body's use of sugar. The bacteria then produce insulin, which can be used to treat people with diabetes. However, some people question the morality of interfering with the hereditary makeup of living things through genetic engineering. Other people are concerned that the release of genetically engineered organisms into the environment may have harmful effects. See **Genetic engineering.**

In 1996, Scottish scientists led by biologist Ian Wilmut successfully cloned a mammal by taking an egg cell from an adult female sheep and replacing the cell's nucleus with one from another adult sheep. The sheep clone they produced was named Dolly. This marked the first time a mammal had been cloned in this way, and it sparked a debate about the potential cloning of humans.

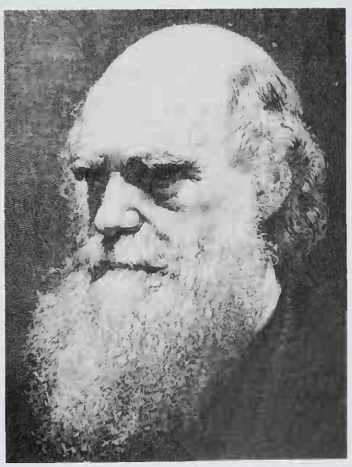
In 1990, geneticists from around the world launched the Human Genome Project. This project seeks to obtain the *sequence,* or order, of all DNA in the *genome* of humans and other organisms. A genome consists of all genes on the chromosomes of a cell. In June 2000, the Human Genome Project and Celera Genomics Corporation, a private company, announced that together they had sequenced essentially the entire human genome. In 2001, American and British scientists used these findings to determine that the human genome has about 30,000 to 40,000 genes, far fewer than previously believed. These scientists also found that humans share many genes with such primitive organisms as bacteria.

Careers in biology

To prepare for a career in biology, students should take such high school and college courses as chemistry, mathematics, and physics as well as biology. A bachelor's degree is sufficient for some biology careers, but

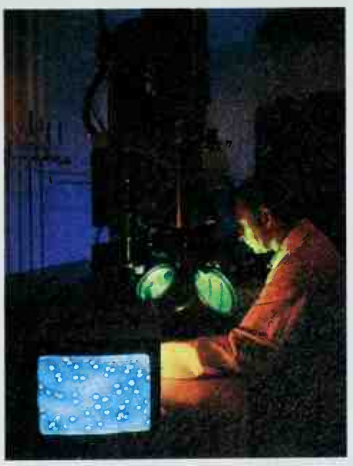
From Schwann's *Microscopical Researches.* 1839

Drawings of cells made by Theodor Schwann of Germany in the late 1830's helped convince scientists that all plants and animals are made up of cells.



SEF/Art Resource

Charles Darwin, a British naturalist, set forth his theory of evolution in *The Origin of Species* (1859). Darwin's ideas revolutionized biological thought.



© Hank Morgan

Genetically engineered yeast, shown on the screen, produce a hepatitis vaccine. Many new uses of genetic engineering are predicted for the future.

many positions require a graduate degree. Some people with a bachelor's degree teach in junior high and high schools. Others work as technicians in research laboratories. Many biologists with advanced degrees teach and conduct research at universities.

Job opportunities for biologists in agricultural research and in industry are increasing, especially in the areas of genetic engineering and ecology. Such biologists may work to develop new varieties of food crops or to create organisms capable of producing drugs.

Many government agencies responsible for public health, sanitation, and water quality employ biologists. Careers in biology also include work in zoos and botanical gardens. Some specialists in ecology and wildlife management work in state and national parks. In addition, some companies and government agencies hire biologists to study the environmental effects of pollution and of proposed construction projects. Garland E. Allen

Related articles in *World Book.* See the Trans-Vision three-dimensional pictures with the article Human body. See also:

Biographies

Agassiz, Louis
Aristotle
Baer, Karl E. von
Bates, Henry W.
Bernard, Claude
Carson, Rachel
Carver, George W.
Commoner, Barry
Crick, Francis H. C.
Cuvier, Baron
Darwin, Charles R.
Dubos, René J.
Elton, Charles S.
Franklin, Rosalind Elsie
Galton, Sir Francis
Galvani, Luigi
Gould, Stephen J.
Gray, Asa
Haeckel, Ernst H.
Harvey, William
Hippocrates
Huxley, Sir Julian S.
Huxley, Thomas H.
Just, Ernest E.
Koch, Robert
Lamarck, Chevalier de
Landsteiner, Karl
Leeuwenhoek, Anton van
Linnaeus, Carolus
Lysenko, Trofim D.
Mendel, Gregor J.
Morgan, Thomas H.
Pasteur, Louis
Pavlov, Ivan P.
Perutz, Max F.
Selye, Hans
Spallanzani, Lazzaro
Vesalius, Andreas
Virchow, Rudolf
Waksman, Selman A.
Wallace, Alfred R.
Watson, James D.
Weismann, August

Branches of biology

Anatomy
Bacteriology
Biochemistry
Biophysics
Botany
Cryobiology
Ecology
Embryology
Entomology
Ethology
Exobiology
Genetics
Gnotobiotics
Histology
Ichthyology
Limnology
Marine biology
Medicine
Microbiology
Molecular biology
Ornithology
Paleontology
Pathology
Phenology
Physiology
Sociobiology
Veterinary medicine
Zoology

Life and life processes

Adaptation
Assimilation
Balance of nature
Biogenesis
Biological clock
Breeding
Clone
Death
Decay
Disease
Evolution
Fertilization
Germination
Growth
Heredity
Hibernation
Homeostasis
Life
Life cycle
Mutation
Natural selection
Nutrition
Photoperiodism
Photosynthesis
Pregnancy
Regeneration
Reproduction
Spontaneous generation
Symbiosis

Other related articles

Archaea
Animal
Bacteria
Biodiversity
Biosynthesis
Cell
Chromosome
Classification, Scientific
DNA
Egg
Embryo
Environment
Fossil
Gene
Genetic engineering
Habitat
Human body
Hybrid
Plant
Protoplasm
RNA
Tissue
Virus

Outline

I. What biologists study
II. History of biology
III. Careers in biology

Questions

What is *genetic engineering*?
How did Antoine Lavoisier describe respiration?
What is the *cell theory*?
How did Galen gain much of his knowledge of anatomy?
Why did many biologists of the 1700's come to believe that species change over time?
How do living things and nonliving things differ?
Whose book contained the first drawings of cells?
What is *natural selection*?
Who is often called the father of modern medicine?
What are some careers in biology?

Additional resources

Janovy, John, Jr. *On Becoming a Biologist.* Univ. of Neb. Pr., 1996.
Margulis, Lynn, and Sagan, Dorion. *What Is Life?* Simon & Schuster, 1995.
Mayr, Ernst. *This Is Biology: The Science of the Living World.* Belknap, 1997.
Smith, Miranda. *Living Earth.* Dorling Kindersley, 1996.

Bioluminescence, *BY oh LOO muh NEHS uhns,* is the ability of certain living things to give off light. It is the result of chemical processes that go on in the tissues of animals or plants. A special enzyme converts chemical energy stored in the cells into light. This process does not produce any significant heat. Most luminescent animals are found in the ocean. For example, many squids are luminescent. Fireflies are a familiar land example. Certain bacteria and fungi also are luminescent. Bioluminescence is studied by scientists attempting to discover a means of producing light chemically without heat. See also **Firefly; Lanternfish; Sardine.** George B. Johnson

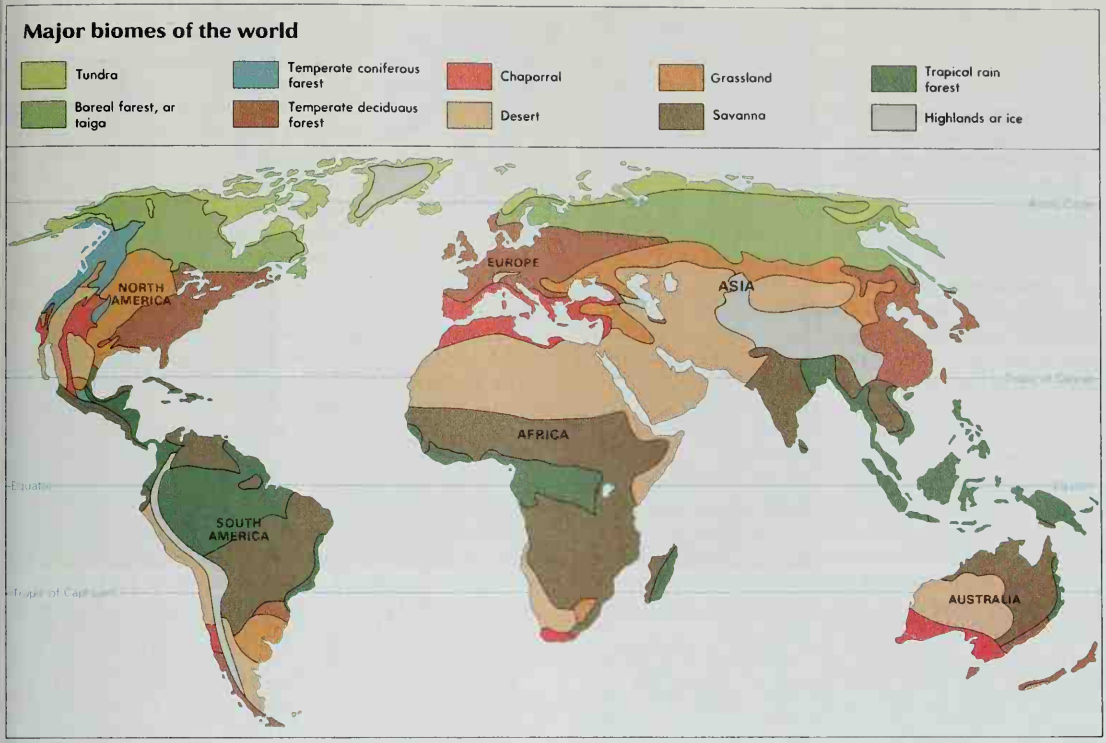
Biomass, *BY oh MAS,* is any organic material that can be converted into energy or into a source of energy. It includes such waste products as cornstalks, spoiled grain, tree limbs, scrap paper, garbage, and manure. Farmers grow sugar cane, certain trees, seaweed, and other crops as biomass. The term *biomass* also refers to the amount of living material in a specific area.

One can convert biomass by burning, by fermentation, or by treatment with chemicals or bacteria. Fermentation produces the fuel ethanol. Chemical treatment produces such fuels as synthetic gas, methane, and fuel oil. Treatment with bacteria yields alcohols, chemicals, or methane. See **Fermentation.**

Biomass may someday become an important source of energy. Today, most of our energy comes from *fossil fuels,* including coal, oil, and natural gas. Supplies of these fuels are running out, however. Furthermore, the burning of fossil fuels adds to the amount of carbon dioxide in the atmosphere, which may well contribute to a warming of the atmosphere known as the *greenhouse effect.* See **Greenhouse effect.**

Biomass, on the other hand, is plentiful and can be continually replenished. In addition, use of biomass can return to the atmosphere no more carbon dioxide than the amount that the biomass removed from the atmosphere as it grew. James C. Linden

Biome, *BY ohm,* is a plant and animal community that covers a large geographical area. The boundaries of different biomes on land are determined mainly by climate. Aquatic biomes are not easily defined.



WORLD BOOK map adapted from *Physical Elements of Geography* by Trewartha, Robinson, and Hammond
Copyright © 1967 by McGraw-Hill, Inc. Used with permission of McGraw-Hill Book Company.

Major land biomes

Biome	Climate	Dominant plants*	Examples of common animals*
Tundra	Extremely cold, dry; permanently frozen subsoil	Lichens, low shrubs, sedges	Arctic foxes, lemmings, polar bears, caribou, wolves, many migratory birds
Boreal forest (*taiga*)	Cold winters, short growing season	Coniferous evergreen trees, chiefly balsam fir, black spruce, jack pine, and white spruce	Bears, moose, wolves, ducks, loons
Temperate coniferous forest	Cool, moist mountain slopes; coastal areas with mild winters and heavy rainfall	Coniferous evergreen trees, including cedar, hemlock, pine, and redwood	Bears, elk, mountain lions, wolves
Temperate deciduous forest	Cold winters, warm summers, moist	Broadleaf deciduous trees, such as elm, maple, and oak	Deer, raccoons, squirrels, many kinds of small birds
Chaparral	Rainy, mild winter, hot, dry summer; fires common	Shrubs with hard leaves, such as scrub oak and manzanita	Coyotes, mule deer, many species of lizards
Desert	Extremely dry	Cacti, sparse grasses, small-leaved shrubs	Lizards, snakes, many small rodents, such as kangaroo rats
Grassland	Temperate, subhumid	Grasses and other herbaceous plants	Antelope, pronghorn, bison, wolves, coyotes
Savanna	Long dry season	Grasses and scattered clumps of trees, such as acacia and baobab trees†	Giraffes, zebras, jackals, lions†
Tropical rain forest	Warm and wet all year	Broadleaf evergreen trees, some palms and tree ferns, climbing vines	Bats, colorful birds, lizards, monkeys, snakes
Tropical seasonal forest	Warm, with wet and dry seasons	Broadleaf deciduous trees, palm trees, bamboo and other grasses	Monkeys, frogs, spiders

*Species representative of North American biomes, except for savanna and tropical rain forest.
†Species representative of African tropical savanna.

Important land biomes include (1) tundra, (2) coniferous forests, (3) deciduous forests, (4) grasslands, (5) savannas, (6) deserts, (7) chaparral, (8) tropical rain forests, and (9) tropical seasonal forests. Most ecologists distinguish between the temperate coniferous forest biome and the northern coniferous forest biome, also known as the *boreal forest biome* or the *taiga biome.*

Each biome has distinctive kinds of plants and animals, as well as a specific climate. For example, northern coniferous forests have a harsh climate with long, cold winters and short summers. The major plants in this biome are cone-bearing evergreen trees, such as spruces, firs, and pines. Moose, caribou, and other deer are the dominant plant-eating animals in northern coniferous forests. Some ecologists name biomes to show the importance of both animals and plants. The northern coniferous forest is sometimes called the spruce-moose biome, and the temperate deciduous forest also may be referred to as the oak-deer-maple biome.

The same biome includes similar communities that occur in different parts of the world. For example, the grassland biome includes the steppes of Asia, the prairies and plains of North America, the veld of southern Africa, and the pampas of South America. The species of grasses may differ in each of these regions. But these areas all share the same form of vegetation.

The ways in which plants and animals in a biome interact with each other determine their *niche* in the biome. A niche is the ecological "job and address" of a plant or animal in nature. The "job" refers to the function of the plant or animal, and the "address" refers to its habitat in the biome. For example, grazing is a major function of many animals in the grassland biome. *Bison* (American buffaloes) were once the dominant grazers on North American grasslands. Today, on African grasslands, zebras and some gazelles and antelope together fill the grazing niche. Plants or animals that fill the same niche in different places, such as bison in North America and gazelles in Africa, are called *ecological equivalents.*

Many plants and animals have special features that make them well-adapted for life in their particular biome. For example, cactuses are found in the desert biome. These plants have fleshy stems to store water and spines to help protect them from plant-eating desert animals. Some animals living in the tundra biome are white in winter and brown in summer. Such coloration makes it easier for these animals to blend with snow in winter and vegetation in summer.

Eric G. Bolen

Related articles in *World Book* include:

Arctic (Natural resources)	Desert	Grassland	Rain forest
	Ecology	Habitat	Savanna
	Forest (Kinds of forests)	Plant	Tundra
Chaparral			

Biomedical engineering is a branch of engineering that applies engineering knowledge to solve problems in biology and medicine. Biomedical engineers are health-care professionals, like doctors, nurses, and medical technicians. Some of these engineers help diagnose and treat human disorders. Others do research, design medical instruments, or work with doctors to develop more technologically advanced medical procedures.

Specialty areas of biomedical engineering

There are a number of well-established specialty areas in biomedical engineering. They include (1) bioinstrumentation, (2) biomechanics, (3) biomaterials, (4) systems physiology, (5) clinical engineering, and (6) rehabilitation engineering. Newer areas include bioinformatics, biotechnology, and tissue and biochemical engineering.

Specialists in these areas often depend on one another. For example, engineers developing an artificial hip rely on biomechanical studies of the forces applied to the natural hip. Similarly, engineers designing systems to electrically stimulate and control paralyzed muscles use knowledge of the interaction of muscles and bones. In both cases, specialists in biomaterials are consulted in selecting materials used in the devices.

Bioinstrumentation uses electronics and measurement principles and techniques to develop devices that monitor, diagnose, and treat diseases. Computers have grown increasingly important in this area. They monitor patients during surgery or in intensive care. They also monitor healthy people in unusual environments, such as astronauts in space or divers deep in the ocean.

Bioinstrumentation engineers develop and investigate many tools to detect, diagnose, and study biological conditions. For example, medical imaging systems apply energy, such as X rays or sound waves, to the body to create detailed pictures of internal structures. Biosignal processors, used in some medical devices, detect, classify, and analyze signals produced by the human body.

Biomedical engineers have developed certain lasers and other devices to help treat disorders. Lasers, which produce narrow, powerful beams of light, make possible bloodless surgery on blood vessels, nerve fibers, retinas, and corneas. Automated infusion pumps continuously deliver the drug insulin to diabetic patients.

Biomechanics applies *mechanics* (the study of how forces affect matter) to biological or medical problems. It deals with the effects of various forces on the body. These forces include stresses applied to the skeleton by gravity and the muscles. Biomechanical engineers also study the flow of fluids in the body and the transfer of chemicals across membranes and synthetic materials.

Biomechanical research has led to the development of the artificial heart and replacement heart valves, the artificial kidney, and the artificial hip. Biomechanics also has greatly improved understanding of the functions of organ, muscle, and bone systems.

Biomaterials concerns the development and selection of appropriate materials to place inside the human body. Such selection ranks among the most difficult tasks faced by biomedical engineers. It demands an understanding of the physical and chemical properties of the living tissue that a material will assist or replace. The material to be implanted must cause no harmful effects, such as poisonous reactions or cancer. In turn, the body must not damage the materials of the implant. For most devices implanted for a long period of time, the materials must be chemically inactive, durable enough to withstand the repeated stresses of a lifetime, and harmless to the tissues and blood. Implantable materials include certain ceramics, metal alloys, and plastics.

Systems physiology uses engineering strategies, techniques, and tools to gain a broad, integrated understanding of the body functions in living organisms. Through experiments, systems physiologists observe and measure basic physiological events, such as *metab-*

Zefa

Model Instruments Company (© Tom Kirkendall)

Artificial body parts are designed by biomedical engineers as replacements for defective natural body parts. A metal replacement hip joint, *far left,* is displayed in front of an X-ray image of the natural joint. The photograph at the near left shows a biomechanical engineer testing the effects of stress on an artificial foot.

olism (the chemical processes of living cells) and the control of limb movements. They then analyze the experimental data, often by developing physical or mathematical models of the events. These analyses enable other biomedical engineers to devise instruments and methods for understanding and solving medical problems.

Clinical engineering applies technology to health care in hospitals. Clinical engineers are responsible for developing and maintaining computer databases of medical equipment records and for purchasing and using sophisticated medical instruments. They often work with doctors, nurses, and other hospital staff to adapt instruments to specific needs. Such tasks may involve coordinating instruments with computer systems and customized software for instrument control and data analysis. For example, clinical engineers may develop a computerized analyzer for blood samples or a computer-based system for managing the care of burn patients.

Rehabilitation engineering develops devices and procedures to expand the capabilities of disabled people and so improve the quality of their lives. Rehabilitation engineers design products that can be adapted to particular needs. For example, they may design a seating support that can conform to any body shape so that many disabled people can sit upright. Rehabilitation engineers often develop products for a specific disabled individual and work directly with that person.

Developing areas in biomedical engineering are important to genetic research, health care delivery, and information systems. Bioinformatics, for example, deals with the information contained in biological systems. Biotechnology includes the production of therapeutic drugs and technologies to correct genetic defects. Tissue engineering involves the design of tissue and tissue-like environments to replace human cells and organs.

Biomedical engineering in the community

The kinds of institutions that employ biomedical engineers include research institutions, government regulatory agencies, hospitals, and industrial firms. Biomedical engineers often use their background in engineering and medicine to perform a coordinating role.

In research institutions, biomedical engineers may supervise laboratories and equipment. They also take part in research with investigators of other backgrounds. Government positions often involve product testing and safety, as well as setting safety standards for devices. In hospitals, biomedical engineers give advice on selecting and using medical equipment, and supervise equipment testing and maintenance. These engineers may also develop customized devices for special health-care or research needs. In industry, biomedical engineers use their understanding of living systems and technology to design and test new products. John D. Enderle

Related articles in *World Book* include:

Artificial heart
Artificial limb
Electrocardiograph
Electroencephalograph
Engineering (picture: Biomedical engineers)
Laser
Magnetic resonance imaging

Bionics is a term that was originally applied to a variety of scientific projects involving biological systems, engineering systems, and artificial intelligence (see **Artificial intelligence**). Many of these projects used biological principles to solve engineering problems. Since the mid-1970's, use of the term *bionics* has become increasingly popular among the general public to describe work on artificial organs and related medical devices. Scientists who work with such devices generally do not use the term. William H. Dobelle

Biophysics is the field of biology that applies the tools and techniques of physics to the study of life processes. These tools include electron microscopy, *X-ray diffraction, magnetic resonance spectroscopy,* and *electrophoresis* (see **Diffraction** [Uses of diffraction]; **Electrophoresis; Magnetic resonance imaging**). Biophysicists use these tools to investigate the molecular structure of proteins, nucleic acids, viruses, and parts of cells, such as chromosomes and ribosomes.

A principal goal of biophysics is to determine the relationship between the structure of a molecule and its

biological function. For example, in photosynthesis, the process by which plants make food, chlorophyll molecules absorb light energy and transform it into chemical energy. Through X-ray diffraction, biophysicists located and determined the structure of specialized *reaction centers* where this energy transformation occurs. Research with spectroscopic instruments then provided details of processes within the reaction centers. Such studies have furthered understanding of photosynthesis. See **Chlorophyll.** Robert Haselkorn

Biopsy, *BY ahp see,* is a medical technique by which living tissue is obtained for examination under the microscope. For example, a doctor may remove a small piece of tissue from a patient's tumor. This tissue may be frozen immediately and sliced into extremely thin sections. When a pathologist examines the tissue under a microscope, it can be determined whether the tumor is *benign* (noncancerous) or *malignant* (cancerous). This information is important to the doctor in deciding how to complete the operation. Malignant tumors tend to *invade* (grow into) surrounding tissues. If the tumor is malignant, a surgeon often must remove large amounts of tissue surrounding it in order to be sure of complete removal of the tumor cells. But if the tumor is benign, doctors usually remove only the tumor. See **Tumor.**

Biopsy also serves as an aid to the diagnosis of certain diseases. In these diseases, characteristic kinds of cells appear in specific places in the body. For example, certain diseases cause changes in the appearance of the cells in the lymph nodes (see **Lymphatic system**). Lymph nodes can be examined easily, because some of them lie just under the skin. Doctors may also obtain tissue for microscopic examination by scraping *epithelial* tissues (the tissues that line the surfaces of the body cavities). They may obtain bits of tissue from structures, such as the liver or kidney, deep inside the body by using a hollow needle. Cells from bone *marrow* (soft spongy material in the center of bones) can be removed by suction through the needle. Specific diseases are indicated by the presence of certain types of cells in excessive numbers in the marrow. Carol Fabian

Biorhythm is a term that refers to any cycle of changes in the functions of organisms. Examples of biorhythms include the menstrual cycle of women and the annual shedding of leaves and growing of new ones by many kinds of trees.

Some people believe there are three biorhythms that can be used to predict day-to-day variations in a person's feelings and abilities to perform physical and mental tasks. This article discusses such biorhythms. They are: (1) a 23-day physical cycle, (2) a 28-day emotional cycle, and (3) a 33-day intellectual cycle.

The three cycles are said to begin at birth and continue with absolute regularity until death. The conditions that the cycle controls are favorable during the first half of each cycle and unfavorable during the second half. A person is most likely to experience accidents or other bad luck on *critical days*. Such days occur on the first day of each new cycle and on days when a rhythm changes from its favorable to its unfavorable phase.

Research has not been able to verify the three cycles and most biologists do not believe that the cycles exist. In addition, biologists know that some human biological rhythms begin before birth, not at birth. Scientists also point out that the characteristics of all known human biological rhythms vary with a person's age.

Michael H. Smolensky

See also **Biological clock.**

Biosphere. See **Earth** (The biosphere).

Biosynthesis is the process by which living cells manufacture complicated chemical compounds from simpler substances. For example, simple molecules called amino acids are put together to make proteins. In plants, carbon dioxide is synthesized into sugars and starch.

Like a factory, every cell needs raw materials, workers, and a power source before it can turn out its products. The raw materials for biosynthesis are the relatively simple chemical compounds that human beings and animals obtain from digested food; that plants obtain from photosynthesis and respiration; and that microorganisms, such as bacteria and yeast, take from their surroundings. The workers of the cell are *enzymes*, molecules that speed up biochemical reactions. Most enzymes are proteins. A cell contains from hundreds to thousands of kinds of enzymes. Each kind is responsible for speeding up a specific reaction or group of similar reactions.

One of the cell's major power sources is *adenosine triphosphate* (ATP), which is a compound that is rich in energy. Special enzymes release the energy contained in ATP whenever power is needed to drive a reaction. Human beings and animals, and most bacteria, constantly restock their supplies of ATP by taking energy released from digested food. Plants renew their ATP supplies chiefly by trapping energy from the sun.

Frederick B. Rudolph

See also **Cell** (The work of a cell).

Biotechnology is the term for techniques of managing biological systems for human benefit. The best-known form of biotechnology is genetic engineering, which involves altering the genes of a living organism. Other examples of biotechnology include *cell cultures* (growths of animal or plant cells in the laboratory) and *monoclonal antibodies* (specialized protein molecules). See **Culture** (biology); **Genetic engineering; Monoclonal antibody.**

Biotechnology has important applications in medicine, agriculture, industry, and other fields. For example, genetically altered microbes can manufacture a wide range of products, including human protein drugs, animal growth hormones, and raw materials for industrial chemicals.

However, biotechnology has generated public concern, particularly about the ethics and safety of certain uses of genetic engineering. In the United States, a number of federal agencies regulate biotechnological research and its products. Thomas H. Maugh II

See also **Gene therapy; Medical ethics.**

Biotic environment. See **Environment.**

Biotite. See **Mica.**

Bipolar disorder is a serious mental illness in which a person alternates between periods of severe depression and periods of *mania* (extreme joy, overactivity, or irritability). The illness is also called *manic-depressive illness* or *manic depression*. Approximately 3 million people in the United States suffer from bipolar disorder. If treated inadequately, the illness can have tragic consequences, such as suicide.

In a period of depression, a person suffering from bipolar disorder may feel sad, anxious, irritable, hopeless, or unmotivated. Depressed patients may experience insomnia or excessive sleeping, decreased or increased appetite, weight loss or weight gain, slowing of thought and movement, and poor memory and concentration. Many think about wanting to die and have unrealistic feelings of guilt.

In a period of mania, a person may experience *euphoria* (indescribable happiness). The person may also be unusually irritable or may alternate between euphoria and irritability. Manic patients sometimes behave inappropriately. For example, they may laugh uncontrollably at funerals. Periods of mania also are characterized by increased energy, racing thoughts, increased rate of speech, decreased need for sleep, exaggerated sense of self-worth, and poor judgment.

Periods of depression and mania may follow one another at intervals of days, weeks, or months. Some patients experience mania and depression at the same time. They are among the most severely affected bipolar patients.

Scientists believe genetic factors cause many cases of bipolar disorder. About half of all patients first show signs of the illness in their teen-age years. Treatment for the disorder includes drugs and psychotherapy. The most commonly prescribed medications are lithium, carbamazepine, and valproate. Steven C. Dilsaver

See also **Depression; Mental illness** (Mood disorders).

Birch is the name of a group of about 40 slender trees and shrubs of North America, Europe, and Northern Asia. They have a thin bark that peels in horizontal layers. Some birches have bark which separates into sheets almost like paper. Birches produce long *catkins* (scaly spikes) which contain tiny flowers. The closed male catkins appear in the autumn, the female ones the following spring. Birch trees may grow in pairs or clusters. Their leaves grow alternately on the twig. Birch nutlets are small and grow in a cone.

Paper birch has a bark that comes off in strips. The bark is thin and light enough to write on. Paper birch is also called *white birch.* Sometimes it is called *canoe birch,* because the Indians used its bark to make birchbark canoes. Indians still make ornaments and small baskets of birchbark.

Paper birch grows 60 to 80 feet (18 to 24 meters) high. It has a few erect branches and many small horizontal ones. It grows in Canada as far north as the *tundra* (treeless plain), in the northern United States, and in the southern Appalachians. The *European white birch* grows in northern Europe and has a variety called the *weeping birch.* Siberians collect the sap of the weeping birch in spring to make syrup.

© Dwight R. Kuhn

Kitty Kohout, Root Resources

Trunk and fruit of the paper birch

Sven Samelius

The birch is a tall, graceful tree with delicate branches. The slender trunk of the birch has thin, peeling bark.

Yellow birch, sometimes called *silver birch,* has yellowish or dark-gray bark when fully grown. The young twigs have bronze bark. The yellow birch is from 50 to 75 feet (15 to 23 meters) tall and has a broad, round top. Its bark grows in thin layers which often break and form loose ends, making the tree look ragged. The yellow birch grows in the Canadian province of Newfoundland and Labrador, as far west as Minnesota, and as far south as North Carolina and Tennessee. Yellow birch is good for timber and for making furniture.

River birch is sometimes called the *red birch.* It grows along the banks of rivers, ponds, and marshes. The river birch grows in Massachusetts, as far south as Florida, and as far west as Texas. The young river birches have salmon-pink bark. Later, the bark may turn almost black. The river birch is a medium-sized tree 50 to 60 feet (15 to 18 meters) high. It is the only typical birch of the South.

Sweet birch is sometimes called the *cherry birch,* or *black birch.* When full-grown, it is between 60 and 80 feet (18 to 24 meters) tall and has a rounded top. Its branches are slender, with delicate twigs which have a wintergreen flavor like that of the yellow birch. Sweet birch grows in Maine, as far south as Georgia, and as far west as Michigan. Its wood is dark, hard, and close-grained. Sweet birch is valuable for making furniture and for interior finish.

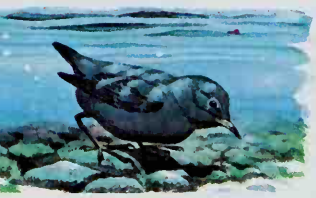
Gray birch is a small graceful tree which seldom grows higher than 40 feet (12 meters). It grows along the Atlantic Coast from Nova Scotia as far south as Delaware and the Blue Ridge Mountains and northwest as far as Lake Ontario. The gray birch has a hard grayish-white bark. The layers of bark grow tightly together, but they can be separated. Dark, V-shaped patches appear on the bark just below the branches. Gray birchwood is used for firewood and in making spools, shoe pegs, and wood pulp. Ross W. Wein

Scientific classification. Birches belong to the birch family, Betulaceae. The scientific name for the paper birch is *Betula papyrifera.* The yellow birch is *B. alleghaniensis.* The river birch is *B. nigra.* The sweet birch is *B. lenta,* and the gray birch is *B. populifolia.*

See also **Alder; Tree** (Familiar broadleaf and needleleaf trees [picture]).

A male Count Raggi's bird-of-paradise courts a mate by spreading his elegant feathers.

The California condor is almost extinct. The bird lives mostly in captivity. It lays only one egg every two years.



An American dipper walks underwater in search of insects and small fish. It stays underwater by tilting its wings slightly upstream.

WORLD BOOK illustrations by Tom Dunnington

Bird

Bird is an animal with feathers. All birds have feathers, and they are the only animals that have them. But when people think of birds, they usually think first of their flying ability. All birds have wings. The fastest birds can reach speeds well over 100 miles (160 kilometers) per hour. No other animals can travel faster than birds. However, not all birds can fly. For example, ostriches and penguins are flightless. Instead of flying, ostriches walk or run. They use their wings only for balance. Penguins swim. They use their wings like flippers.

People have always been fascinated by birds. Their marvelous flying ability makes them seem to be the freest of all animals. Many birds have gorgeous colors or sing sweet songs. The charms of birds have inspired poets, painters, and composers. Certain birds also serve as symbols. People have long regarded the owl as a symbol of wisdom and the dove as a symbol of peace. The eagle has long represented political and military might. The bald eagle is the national symbol of the United States. Birds also played a role in the development of the airplane. Inventors built successful planes only after they patterned the wings after a bird's wings.

There are about 9,700 kinds of birds. The smallest bird is the bee hummingbird, which grows only about 2 inches (5 centimeters) long. The largest bird is the ostrich, which may grow up to 8 feet (2.4 meters) tall. Birds live in all parts of the world, from the polar regions to the tropics. They are found in forests, deserts, and cities; on grasslands, farmlands, mountaintops, and islands; and even in caves. Ducks, gulls, and certain other birds always live near water. Most such birds can swim. Some birds, especially those in the tropics, stay in the same general area throughout life. Even in the Arctic and the Antarctic, some hardy birds stay the year around. But many birds of cool or cold regions migrate each year to warm areas to avoid winter, when food is hard to find. In spring, they fly home again to nest.

All birds hatch from eggs. Among most kinds of birds, the female lays her eggs in a nest built by herself or her mate or by both of them. The majority of birds have one mate at a time, with whom they raise one or two sets of babies a year. Some birds keep the same mate for life. Others choose a new mate every year. Most baby birds remain in the nest for several weeks or months after hatching. Their parents feed and protect them until they can care for themselves. Most birds leave their parents when they are a few months old.

Scott M. Lanyon, the contributor of this article, is Director of the James Ford Bell Museum of Natural History.

© David C. Fritts, Animals Animals

The ptarmigan hides from enemies by blending with its surroundings. In winter, the bird has white feathers, making it almost invisible against the snow. In summer, the ptarmigan's feathers are speckled and so match the vegetation on the ground, where the bird makes its nest.

© Charles G. Summers Jr., DPI

Birds belong to the large group of animals called *vertebrates*. Vertebrates are animals with a backbone. The group also includes fish, reptiles, and mammals. Birds have two forelimbs and two hindlimbs, as do cats, dogs, monkeys, and most other mammals. But in birds, the forelimbs are wings rather than arms or front legs. Like mammals, and unlike amphibians and reptiles, birds are *warm-blooded*—that is, their body temperature always remains about the same, even if the temperature of their surroundings changes. Unlike most other vertebrates, birds lack teeth. Instead, they have a hard bill, or beak, which they use in getting food and for self-defense.

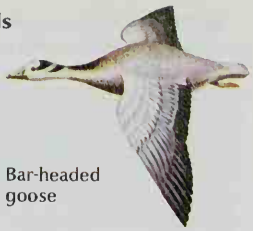
Many birds are valuable to people. Such birds as chickens and ducks provide meat and eggs for food. Birds help farmers by eating insects that attack their crops. Some types of birds eat farmers' grain and fruit. But in general, birds do much more good than harm.

Since the 1600's, about 80 kinds of birds have died out. People have killed off most of them by destroying their environment to create farms and cities. Today, most countries have laws to protect birds and help prevent any more kinds from dying out.

This article discusses the importance of birds, their distribution throughout the world, how they live, and how they raise a family. The article also describes bird migration, the bodies of birds, bird study and protection, and the development of birds.

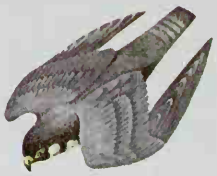
Interesting facts about birds

The highest flyer is the bar-headed goose. Some flocks of bar-headed geese fly over the world's highest mountain range, the Himalaya in Asia, at an altitude of more than 25,000 feet (7,625 meters).



Bar-headed goose

The fastest diver is the peregrine falcon. The bird's broad, powerful wings and streamlined body enable it to swoop down on its prey at a speed of more than 200 miles (320 kilometers) per hour.



Peregrine falcon

The largest bird is the male African ostrich. It may grow as tall as 8 feet (2.4 meters) and weigh as much as 300 pounds (140 kilograms).

Ostrich

The smallest bird is the bee hummingbird. When fully grown, it measures about 2 inches (5 centimeters) and weighs about $\frac{1}{10}$ ounce (3 grams). The nest of a bee hummingbird is the size of half a walnut shell.

Bee hummingbird

The greatest traveler. Arctic terns migrate farther than any other bird. They travel about 11,000 miles (17,700 kilometers) each way between their breeding grounds in the Arctic and winter home in the Antarctic.

Arctic tern

The deepest diver is the emperor penguin. Emperor penguins have been recorded underwater at depths of almost 900 feet (275 meters). They use their wings to propel themselves through the water.

Emperor penguin

WORLD BOOK illustrations by Venner Artists, Ltd., James Teason, and John F. Eggert

In nature. Each species of animal in a woodland, grassland, or other natural area depends on other living things in the environment for food. In a woodland, for example, some birds get their food mainly from plants. Others chiefly eat small animals, such as insects or earthworms. Birds and bird eggs, in turn, serve as food for such animals as foxes, raccoons, and snakes. The feeding relationships among all the animals in an environment help prevent any one species from becoming too numerous. Birds play a vital role in keeping this balance of nature. See **Balance of nature.**

Birds also serve other purposes in nature. Fruit-eating birds help spread seeds. The birds eat and digest the pulp of berries and other fruits but pass the seeds in their droppings. The seeds may sprout wherever the droppings fall. Hummingbirds pollinate certain flowers that produce nectar. Hummingbirds feed on nectar. As they visit flowers in search of it, they spread pollen from flower to flower.

Many kinds of birds help farmers by eating weed seeds, harmful insects, or other agricultural pests. Unlike birds that feed on fruits, seed-eating birds digest the seeds they eat. One bobwhite may rid a field of as many as 15,000 weed seeds a day. Many birds eat insects that damage farm crops. Some birds are especially helpful in keeping the number of certain kinds of insects under control. Robins and sparrows, for example, are highly effective against cabbageworms, tomato worms, and leaf beetles. Rats and mice can cause huge losses on farms by eating stored grain. Hawks and owls prey on these animals and so help limit such losses.

A few kinds of birds are considered to be pests. One such species, the European starling, was introduced into the Northeastern United States in the 1890's. The birds multiplied and spread rapidly. Today, starlings are so numerous in many cities of North America that they have become a nuisance because of their noise and droppings. Pigeons are also a nuisance in a large number of cities because of their droppings. Flocks of starlings and pigeons leave masses of droppings on buildings where the birds have been roosting. The fungus *Histoplasma capsulatum* can grow on these droppings. The spores of the fungus may be carried in the air and cause the infectious disease *histoplasmosis* in people who inhale them (see **Histoplasmosis**).

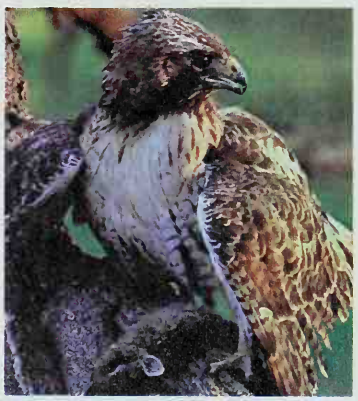
As a source of food and raw materials. People have always hunted birds for food. Some of the first birds used for food were ground-feeding birds, such as quails and turkeys, which were caught in traps and snares. Hunters captured pigeons, ducks, and other birds by placing nets where the birds normally flew. After the invention of guns, most people hunted large, meaty birds to save gunpowder and shot. The eggs of wild birds were also an important food for people in prehistoric times, and such eggs are still eaten in some parts of the world. Because most birds' nests are hard to find, the eggs used for food have come chiefly from sea birds that nest in open places.

People eventually discovered that certain wild fowl could be *domesticated* (tamed). This discovery led to the development of *poultry*—that is, domesticated fowl that farmers raise for meat and eggs. Chickens are probably the oldest kinds of poultry. They were domesticated in Asia at least 3,000 years ago. Since then, farmers have developed other poultry, including ducks, geese, guineafowl, pheasants, and turkeys. Mallard ducks, geese, and pheasants were domesticated in Asia, guineafowl in Africa, and Muscovy ducks and turkeys in Mexico.

Today, chickens are the most widely raised poultry by far. Farmers throughout the world produce hundreds of millions of chickens annually for meat and eggs. Ducks and turkeys rank second and third in production worldwide. Ducks are raised for both meat and eggs. Turkeys are raised mainly for meat.

The feathers of certain birds are used to stuff pillows, mattresses, sleeping bags, and quilting. Goose feathers are preferred because they are soft and springy. Manu-

Some helpful birds Various birds aid farmers by preying on pests or by eating weed seeds. *Scavenger* birds help keep the environment clean by feeding on decaying matter. Examples of helpful birds appear below.



© Jim Brandenburg

Hawks prey on rabbits, rats, and mice—animals that eat stored grain. This red-tailed hawk has captured a rabbit.

© C. C. Lockwood, Animals Animals

A bobwhite eats weed seeds at a rate of up to 15,000 a day. Bobwhites thus help farmers by reducing the spread of weeds.

© Tom Stack

A laughing gull feeds on a rotting fish. Gulls, which eat almost any garbage, help keep beaches and harbors clean.

Birds as a source of food Farmers throughout the world raise certain kinds of birds for meat and eggs. Such birds are called *poultry.* Chickens are the favorite type of poultry, but turkey, ducks, and geese are also popular.

Douglas Dickins

A flock of ducks is kept in a flooded field on the Indonesian island of Bali. Although ducks are raised in many parts of the world, their meat is especially popular in eastern Asia.

B. Josedupont, Jacana

Geese are fattened on grain in a French farmyard. France is one of the world's leading goose-producing countries.

facturers often mix goose feathers with *down feathers,* or *down,* to provide extra softness. Down feathers are small, fluffy feathers that some adult birds, especially water birds, have under their stiffer outer feathers. Most of the down used for stuffing comes from ducks and geese raised on farms.

People throughout the world use colorful bird feathers to decorate jewelry, clothing, and hats. In the United States and Canada, laws forbid the use of feathers from wild birds. People may only use feathers from domesticated birds, such as turkeys, or from other birds raised in captivity, such as peacocks and pheasants.

Over the centuries, the droppings of ocean birds have formed huge deposits in certain areas of the world. This waste matter, which is called *guano,* makes excellent fertilizer. The mining of guano for fertilizer is an important industry in Peru and the small Pacific island nation of Nauru.

As pets. People have long kept certain kinds of birds as pets. Favorite bird pets include canaries, parrots, finches, and parakeets called *budgerigars,* or "budgies." Budgies and parrots are especially popular because they can be trained to imitate human speech and even to whistle.

Most birds sold as pets have been bred scientifically. The birds are hatched in captivity and sold to the public by pet stores. Some of these birds look very different from their wild ancestors. For example, wild budgerigars are green, but breeders have produced white, yellow, blue, and even violet budgerigars. In the past, most of the parakeets and parrots sold as pets were caught in the wild. Over the years, this practice wiped out some species. To help protect such birds, many countries have made it illegal for wild birds to be kept in cages except in zoos. However, many wild parakeets and parrots are still captured and sold illegally.

Birds as pets People have kept birds as pets since ancient times. Certain types of birds are valued for their singing and beauty. Some other birds can be trained to talk and to perform various tricks.

A canary makes a cheerful companion. Most canaries are bright yellow and produce a lively, melodious song.

A budgerigar can be an affectionate and clever pet. "Budgies" are natural acrobats, and most can learn to say words.

WORLD BOOK photos by Kurt Kreutzig, Photographics

A finch sings beautifully, and its lively activities are amusing to watch. Many finches have patches of brilliant color.

The distribution of birds

Every species of bird has its own *range*—that is, a particular part of the world in which all the members of the species normally live. Some birds have a broad range. The common barn-owl, for example, lives on every continent except Antarctica. However, no species of bird is found in every part of the world, and many species have an extremely limited range.

The oceans strongly influence how different species of birds are distributed. Most birds cannot make long ocean flights. Widely separated continents, such as Africa and North America, therefore have different kinds of birds. However, people have transported many species overseas, and some of these birds have become adapted to their new environment.

Climate also influences the ranges of birds. Most birds would starve during a long cold spell. For this reason, relatively few birds live the year around in regions with severe winters. However, many birds nest in such regions in summer and migrate to warmer climates for the winter. Birds that migrate have two ranges—a summer one and a winter one. They are *summer residents* in their summer range and *winter residents* in their winter one. Along their migration route, they are *transients* (temporary visitors). Birds that do not migrate are *permanent residents.*

More kinds of birds live in the tropics than anywhere else in the world. Most of these birds are permanent residents. However, some parts of the tropics have an annual dry season, and many of the birds migrate to moister parts of the tropics to avoid it. The tropics also have many winter residents that migrate from cool or cold climates. The *Temperate Zones*—that is, the parts of the world between the tropics and the polar regions—have fewer permanent residents than do the tropics. In the parts of the Temperate Zones nearest the polar regions, most of the birds are summer residents only. Few birds live all year in the polar regions. However, both the Arctic and the Antarctic have many residents during the summer.

The ranges of birds are further limited by the kinds of food and nesting places that are available. For example, fish-eating birds must live near bodies of water. Birds that nest in trees normally live only in wooded areas. Thus, most birds live not only in a particular region of the world but also in a particular type of environment, or *habitat,* within that region.

Birds of North America

More than 700 species of birds live in North America north of Mexico. Most of this region lies in the North Temperate Zone. The region includes all of Canada and all of the United States except Hawaii. In the southern part of the region, many of the birds are permanent residents. In the northern part, most of the birds are summer residents only. In summer, the birds mate, lay and hatch their eggs, and raise their families. They then fly south for the winter. Mexico and Central America are part of North America. But most of the birds that reside there permanently are more closely related to those of South America than to U.S. and Canadian birds.

The birds of temperate North America live in seven main kinds of habitats: (1) urban areas, (2) forests and woodlands, (3) grasslands, (4) brushy areas, (5) deserts, (6) inland waters and marshes, and (7) seacoasts. Some North American birds live north of the Temperate Zone—that is, in the Arctic.

State and provincial birds

Bluebird
- Idaho (Mountain bluebird)
- Missouri
- Nevada (Mountain bluebird)
- New York

Blue jay
- Prince Edward Island

Brown thrasher
- Georgia

Bunting
- Colorado (Lark bunting)

Cardinal
- Illinois
- Indiana
- Kentucky
- North Carolina
- Ohio
- Virginia
- West Virginia

Chickadee
- Maine
- Massachusetts
- New Brunswick

Chicken
- Delaware (Blue hen chicken)
- Rhode Island (Rhode Island Red)

Finch
- New Hampshire (Purple finch)

Flycatcher
- Oklahoma (Scissor-tailed flycatcher)

Goldfinch
- Iowa
- New Jersey
- Washington (Willow goldfinch)

Grouse
- Pennsylvania (Ruffed grouse)
- Saskatchewan (Sharp-tailed grouse)

Gull
- Utah (California sea gull)

Loon
- Minnesota (Common loon)

Meadowlark
- Kansas
- Montana
- Nebraska
- North Dakota
- Oregon
- Wyoming

Mockingbird
- Arkansas
- Florida
- Mississippi
- Tennessee
- Texas

Nene (Hawaiian goose)
- Hawaii

Oriole
- Maryland (Baltimore oriole)

Owl
- Alberta (Great horned owl)

Pelican
- Louisiana (Brown pelican)

Pheasant
- South Dakota (Ring-necked pheasant)

Ptarmigan
- Alaska (Willow ptarmigan)

Quail
- California (California valley quail)

Roadrunner
- New Mexico

Robin
- Connecticut (American robin)
- Michigan
- Wisconsin

Thrush
- District of Columbia (Wood thrush)
- Vermont (Hermit thrush)

Wren
- Arizona (Cactus wren)
- South Carolina (Carolina wren)

Yellowhammer
- Alabama*

Each bird listed above in heavy type has an article in WORLD BOOK. Color pictures of the state birds appear with the state articles.
*Yellowhammer is a popular regional name for a bird commonly known elsewhere as the yellow-shafted flicker.

Birds of urban areas

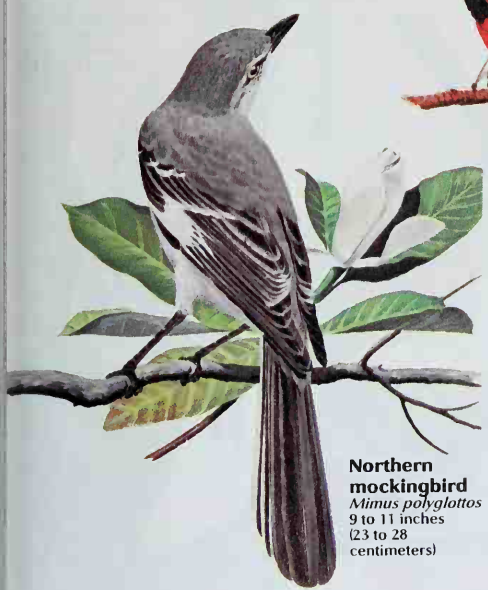
Many birds will nest in urban areas if these areas have nesting places similar to those of the birds' natural habitat. In addition to pigeons and starlings, such birds include robins, blue jays, mockingbirds, cardinals, wrens, and house sparrows. Cardinals and mockingbirds usually nest in shrubs or low trees. Robins and blue jays nest in shade trees. Wrens nest inside holes in hollow trees, bird boxes, and even mailboxes. The house sparrow, which was introduced from Europe, is one of the most common birds in American and Canadian cities. House sparrows will nest in almost any small opening. They are a familiar sight even in the downtown areas of big cities.

House wren
Troglodytes aëdon
4½ to 5¼ inches
(11 to 13.3 centimeters)

American robin
Turdus migratorius
9 to 11 inches
(23 to 28 centimeters)

House sparrow
Passer domesticus
5½ to 6¼ inches
(14 to 16 centimeters)

Northern cardinal
Cardinalis cardinalis
7 to 9 inches
(18 to 23 centimeters)



Northern mockingbird
Mimus polyglottos
9 to 11 inches
(23 to 28 centimeters)

Blue jay
Cyanocitta cristata
11 to 12½ inches
(28 to 32 centimeters)

WORLD BOOK illustrations by Arthur Singer

Birds of forests and woodlands

Some North American birds live chiefly in forests of needleleaf trees. Needleleaf forests cover much of Canada and Alaska and mountainous areas of the western United States. Typical birds of these forests include the Blackburnian warbler, brown creeper, gray jay, red-breasted nuthatch, ruby-crowned kinglet, and winter wren. Certain other birds live chiefly in forests of broadleaf trees. Broadleaf forests grow mainly in the eastern half of the United States and southeastern Canada. Typical birds of these forests include the American redstart, Baltimore oriole, ovenbird, scarlet tanager, tufted titmouse, and white-breasted nuthatch. Some birds, such as the hairy woodpecker and yellow-bellied sapsucker, live in both needleleaf forests and broadleaf forests.

Certain birds prefer *open woodlands* to dense forests. Open woodlands are areas of scattered broadleaf or needleleaf trees. They are found mainly on the edges of forests, along riverbanks, and in suburban areas. Birds that nest in open woodlands include the cedar waxwing, downy woodpecker, house wren, rosebreasted grosbeak, yellow-billed cuckoo, and yellowshafted flicker. Red-eyed vireos are among the most widespread woodland birds of North America. They live in almost any area that has broadleaf trees.

Many birds live at a particular level of a forest or woodland. For example, grosbeaks, tanagers, and many kinds of wood warblers live mainly in the treetops. Nuthatches and woodpeckers live farther down on the branches and trunks. Ovenbirds and winter wrens live chiefly on the forest or woodland floor.

WORLD BOOK illustrations by Arthur Singer

Cedar waxwing
Bombycilla cedrorum
6½ to 8 inches
(16.5 to 20 centimeters)

Purple finch
Carpodacus purpureus
5½ to 6¼ inches
(14 to 15.9 centimeters)

Baltimore oriole
Icterus galbula
7 to 8 inches
(18 to 20 centimeters)

Tufted titmouse
Parus bicolor
6 to 6½ inches
(15 to 16.5 centimeters)

Blackburnian warbler
Dendroica fusca
4½ to 5½ inches
(11 to 14 centimeters)

Scarlet tanager
Piranga olivacea
6½ to 7½ inches
(16.5 to 19 centimeters)
WORLD BOOK illustration by John F. Eggert

WORLD BOOK illustrations by Arthur Singer unless otherwise credited

Birds of grasslands

Until the mid-1800's, prairies covered much of the central United States and south-central Canada. The tall prairie grasses were a favorite nesting place of many birds. Today, most prairies have been plowed under for use as cropland. The birds that have adjusted best to these changes are those that traditionally nest in other open areas in addition to prairies. Such birds include the American kestrel, brown-headed cowbird, dickcissel, horned lark, vesper sparrow, western kingbird, and western meadowlark. Today, these birds nest as readily in or near hayfields and other cultivated grasslands as in native prairies. Horned larks even nest on golf courses.

Some prairie birds have had great difficulty adjusting to the changes in their habitat. For example, prairie chickens were once among the most numerous prairie birds. But prairie chickens nest only among tall grasses. Today, they can be found only in the few remaining native prairies.

Dry grasslands, now used mostly for grazing cattle, cover much of the western parts of the United States and Canada. Birds that nest in these grasslands include the burrowing owl, lark bunting, scissor-tailed flycatcher, and Baird's sparrow. Except for the burrowing owl, these birds have fared better than many of the prairie birds because their nesting places have been less disturbed by agriculture. Burrowing owls traditionally nest in prairie dog burrows. Ranchers regard prairie dogs as pests, however, and try to wipe them out by destroying their burrows. In so doing, they destroy the nesting places of the owls.

Brown-headed cowbird
Molothrus ater
6 to 8 inches
(15 to 20 centimeters)

Vesper sparrow
Pooecetes gramineus
5 to 6 $\frac{1}{2}$ inches
(13 to 16.5 centimeters)

Scissor-tailed flycatcher
Tyrannus forficatus
11 to 15 inches
(28 to 38 centimeters)
WORLD BOOK illustration
by Arthur Singer

Lark bunting
Calamospiza melanocorys
6 to 7 $\frac{1}{2}$ inches
(15 to 19 centimeters)
WORLD BOOK illustration
by Arthur Singer

Western meadowlark
Sturnella neglecta
8 $\frac{1}{2}$ to 11 inches
(21.6 to 28 centimeters)

WORLD BOOK illustrations by John Rignal
unless otherwise credited

Dickcissel
Spiza americana
6 to 7 inches
(15 to 18 centimeters)

American kestrel
Falco sparverius
about 8 inches
(20 centimeters)

Western kingbird
Tyrannus verticalis
8 to 9 $\frac{1}{2}$ inches
(20 to 24 centimeters)

Horned lark
Eremophila alpestris
7 to 8 inches
(18 to 20 centimeters)

Chestnut-collared longspur
Calcarius ornatus
5 $\frac{1}{2}$ to 6 $\frac{1}{2}$ inches
(14 to 17 centimeters)

Burrowing owl
Speotyto cunicularia
9 to 11 inches
(23 to 28 centimeters)

Greater prairie-chicken
Tympanuchus cupido
16 $\frac{1}{2}$ to 18 inches
(42 to 46 centimeters)

WORLD BOOK illustrations by John Rignall

Birds of brushy areas

Some birds make their home in and around brushy areas, which are covered by bushes and low scrubby trees. Such areas are commonly found on the edges of forests and woodlands, between woodlands and grasslands, and in abandoned fields that are developing into woodlands. Such habitats are found throughout the United States and southern Canada. Many of the birds that live in these habitats are also wide ranging. They include the gray catbird, loggerhead shrike, rufous-sided towhee, and yellow-breasted chat. Other birds of brushy habitats have a more limited range. The bobwhite and Carolina wren are permanent residents in the southeastern United States and in Mexico. The painted bunting nests chiefly in the southeastern half of the United States, but migrates to Mexico in winter.

Painted bunting
Passerina ciris
5 to 5¼ inches
(13 to 14 centimeters)

Loggerhead shrike
Lanius ludovicianus
8 to 10 inches
(20 to 25 centimeters)

Brown thrasher
Toxostoma rufum
10 to 12 inches
(25 to 30 centimeters)

Carolina wren
Thryothorus ludovicianus
5¼ to 6 inches
(13.3 to 15 centimeters)

Northern bobwhite
Colinus virginianus
8½ to 10½ inches
(21.6 to 27 centimeters)

Catbird
Dumetella carolinensis
8 to 9¼ inches
(20 to 23.5 centimeters)

WORLD BOOK illustration by John Charles Pitcher

WORLD BOOK illustrations by Arthur Singer unless otherwise credited

Birds of the desert

Many birds that live in the deserts of the Southwestern United States nest in saguaros and other large cactuses. The cactus wren builds its nest among cactus spines. Gila woodpeckers and gilded flickers nest in holes that they make in cactus stems. Elf owls, the smallest members of the owl family, nest in holes that the woodpeckers abandon. A large percentage of desert birds chiefly eat animal flesh or insects. The deserts are dry, and such a diet provides more moisture than a diet of seeds. Meat-eating birds, such as the golden eagle, roadrunner, and various species of owls, are among the most common desert birds. Most of the cactus dwellers mainly eat insects. Gambel's quail and several species of sparrows are among the few ground-nesting, seed-eating birds of the North American deserts.

Golden eagle
Aquila chrysaetos
30 to 41 inches
(76 to 104 centimeters)

Cactus wren
Campylorhynchus brunneicapillus
7 to 8¾ inches
(18 to 22.2 centimeters)

Elf owl
Micrathene whitneyi
5 to 6 inches
(13 to 15 centimeters)

Gila woodpecker
Melanerpes uropygialis
8 to 10 inches
(20 to 25 centimeters)

Gambel's quail
Callipepla gambelii
10 to 11½ inches
(25 to 29 centimeters)

Greater roadrunner
Geococcyx californianus
20 to 24 inches
(51 to 61 centimeters)

WORLD BOOK illustrations by Arthur Singer

Birds of inland waters and marshes

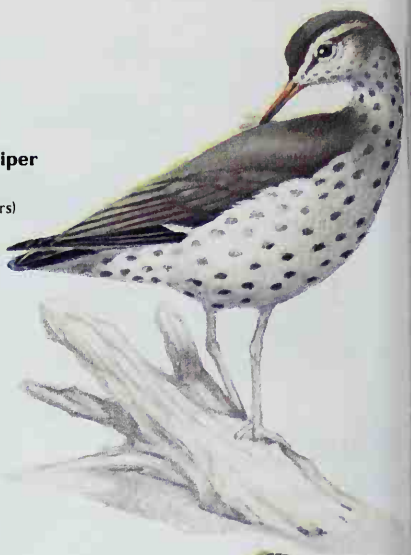
Most water birds swim after their food or dive or wade into the water for it. Few water birds live near fast-moving rivers because swimming, diving, and wading are difficult in a strong current. Lakes, ponds, and marshes are the chief freshwater habitats of birds. The birds nest on the shores of lakes and ponds and on high ground in marshes.

Typical swimming and diving birds of U.S. and Canadian fresh waters include the American coot, California gull, common loon, horned grebe, king rail, and many kinds of ducks. Among the ducks are the American wigeon, blue-winged teal, canvasback, and shoveler. Although some of these birds are excellent swimmers, a number of them feed mostly by wading at the edge of the water. Common wading birds include the American bittern, common snipe, great blue heron, and spotted sandpiper.

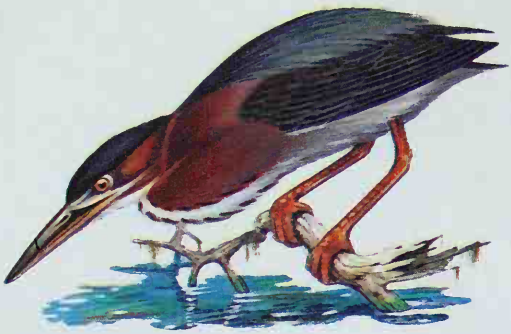
Some land birds have adopted ways of life that keep them close to water. For example, the marsh wren, common yellowthroat, and red-winged blackbird often nest in marshes. The Louisiana waterthrush nests on the banks of streams and feeds on water insects. Belted kingfishers perch alongside bodies of water and dive after fish that swim near the surface.

Some birds of inland waters and marshes also live in saltwater environments. For example, the belted kingfisher, great blue heron, and green-backed heron often nest near the ocean and hunt fish in the shallow coastal waters. Most water birds of the United States and Canada fly south for the winter. Many of these birds make their winter homes near salt water.

Common loon
Gavia immer
28 to 36 inches
(71 to 91 centimeters)



Spotted sandpiper
Actitis macularia
7 to 8 inches
(18 to 20 centimeters)



Green-backed heron
Butorides striatus
18 to 22 inches
(46 to 56 centimeters)

WORLD BOOK illustration by John F. Eggert

Horned grebe
Podiceps auritus
12½ to 15 inches
(32 to 38 centimeters)

Louisiana waterthrush
Seiurus motacilla
About 6¼ inches
(15.9 centimeters)

WORLD BOOK illustrations by Athos Menaboni unless otherwise credited

California gull
Larus californicus
20 to 23 inches
(51 to 58 centimeters)

Canvasback
Aythya valisineria
19 to 24 inches
(48 to 61 centimeters)

American wigeon (Baldpate)
Anas americana
18 to 23 inches
(46 to 58 centimeters)

Great blue heron
Ardea herodias
Stands about 4 feet
(122 centimeters) tall

Blue-winged teal
Anas discors
14 to 17 inches
(36 to 43 centimeters)

Shoveler
Anas clypeata
17 to 22 inches
(43 to 56 centimeters)

Belted kingfisher
Ceryle alcyon
11 to 14 $\frac{1}{2}$ inches
(28 to 37 centimeters)

WORLD BOOK illustration by Arthur Singer

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Birds of the seacoasts

Some American and Canadian water birds normally nest along seacoasts. Along the Atlantic coast, such birds include the American oystercatcher, black skimmer, and common tern. The black oystercatcher, western gull, and Cassin's auklet nest along the Pacific coast. The brown pelican, laughing gull, and Wilson's plover nest along both coasts. Some species, such as oystercatchers and plovers, are shorebirds. Certain others, including auks and auklets, gulls, and terns, sometimes hunt fish far out at sea.

In winter, the southeast, south, and southwest coasts of North America are home to numerous ducks, geese, and many other birds that nest in the Arctic. Many sandpipers and other Arctic birds visit U.S. and Canadian shores en route to winter homes in the tropics.

Common tern
Sterna hirundo
13 to 16 inches
(33 to 41 centimeters)

Laughing gull
Larus atricilla
15 $\frac{1}{2}$ to 17 inches
(39 to 43 centimeters)

American oystercatcher
Haematopus palliatus
17 to 21 inches
(43 to 53 centimeters)

Wilson's plover
Charadrius wilsonia
7 to 8 inches
(18 to 20 centimeters)

Brown pelican
Pelecanus occidentalis
42 to 54 inches
(107 to 137 centimeters)

Black skimmer
Rynchops niger
16 to 20 inches
(41 to 51 centimeters)

WORLD BOOK illustrations by Athos Menaboni

Birds of the Arctic

Northernmost North America, Asia, and Europe lie in the Arctic. Most of this land is *tundra*—that is, cold, dry, treeless marshland. The Arctic tundra is frozen solid most of the year. It comes to life briefly in spring and summer. At that time, many birds that winter in warmer climates arrive in the tundra to breed. Most are water birds. They include the lesser golden-plover, arctic tern, Canada goose, parasitic jaeger, red phalarope, and many species of ducks and sandpipers. Land birds that migrate to the tundra include the horned lark and snow bunting.

Only a few birds live in the Arctic all year. Probably the best known are ptarmigans. These extremely hardy, chickenlike birds survive almost entirely on twigs during the long Arctic winters.

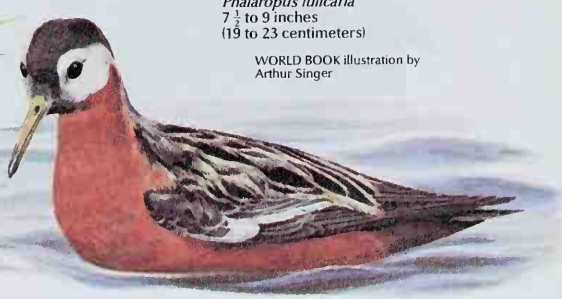
Lesser golden-plover
Pluvialis dominica
9 ½ to 11 inches
(24 to 28 centimeters)

Parasitic jaeger
Stercorarius parasiticus
16 to 21 inches
(41 to 53 centimeters)

Willow ptarmigan
Lagopus lagopus
15 to 17 inches
(38 to 43 centimeters)

Canada goose
Branta canadensis
22 to 40 inches
(56 to 102 centimeters)

Arctic tern
Sterna paradisaea
14 to 17 inches
(36 to 43 centimeters)



Red phalarope
Phalaropus fulicaria
7 ½ to 9 inches
(19 to 23 centimeters)

WORLD BOOK illustration by Arthur Singer

WORLD BOOK illustrations by John Charles Pitcher unless otherwise credited

Birds of the ocean and the Antarctic

Some birds spend most of their time far out at sea and seldom visit land except to breed. These birds include albatrosses, penguins, petrels, shearwaters, and storm-petrels. All these birds except penguins are expert long-distance fliers. Penguins cannot fly. But they swim long distances and remain at sea for months at a time. Certain other birds often hunt food far out at sea but return to land regularly. These birds include boobies, frigatebirds, phalaropes, tropicbirds, and the south polar skua.

Many ocean birds nest on Antarctic islands during summer in the south polar region. A few birds nest on the ice-covered Antarctic continent itself. These hardy species include the emperor penguin, snow petrel, south polar skua, and Wilson's storm-petrel.

WORLD BOOK illustrations by John Charles Pitcher

Birds of Central and South America

Central America and most of South America lie in the tropics. The American tropics have more species of birds than does any other area of the same size in the world. Most birds of this region live in rain forests. The rest live in grasslands, deserts, or dry forests, or near bodies of water. Some tropical American birds are related to U.S. and Canadian species. These birds include various species of blackbirds, hummingbirds, orioles, tanagers, tyrant flycatchers, and wrens. Other birds of tropical America have few or no close relatives except in other tropical regions. These birds include the cock-of-the-rock, barred antshrike, keel-billed toucan, quetzal, and sunbittern. Many birds that nest in the United States and Canada spend the winter in the American tropics.

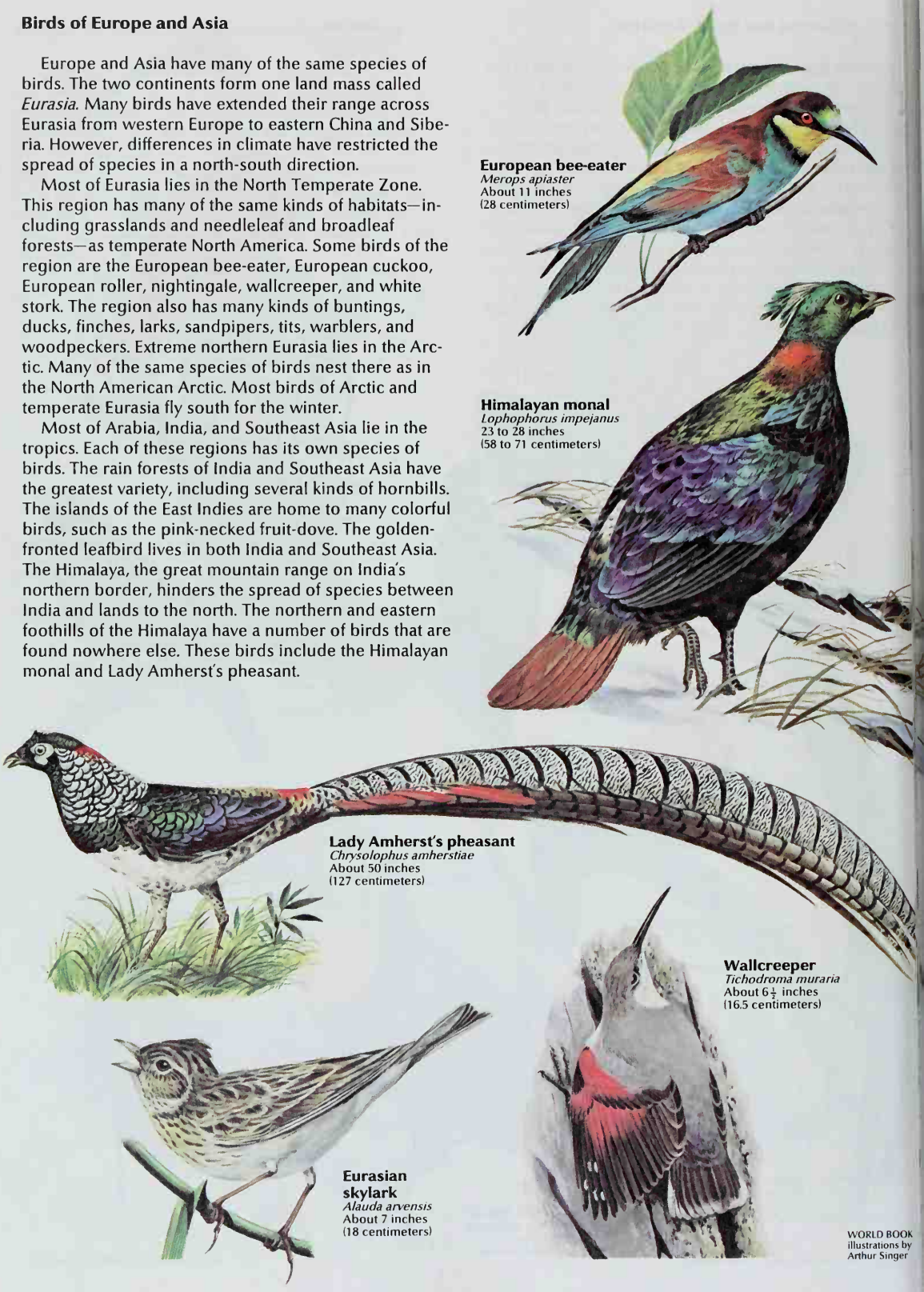
WORLD BOOK illustrations by Arthur Singer

Birds of Europe and Asia

Europe and Asia have many of the same species of birds. The two continents form one land mass called *Eurasia.* Many birds have extended their range across Eurasia from western Europe to eastern China and Siberia. However, differences in climate have restricted the spread of species in a north-south direction.

Most of Eurasia lies in the North Temperate Zone. This region has many of the same kinds of habitats—including grasslands and needleleaf and broadleaf forests—as temperate North America. Some birds of the region are the European bee-eater, European cuckoo, European roller, nightingale, wallcreeper, and white stork. The region also has many kinds of buntings, ducks, finches, larks, sandpipers, tits, warblers, and woodpeckers. Extreme northern Eurasia lies in the Arctic. Many of the same species of birds nest there as in the North American Arctic. Most birds of Arctic and temperate Eurasia fly south for the winter.

Most of Arabia, India, and Southeast Asia lie in the tropics. Each of these regions has its own species of birds. The rain forests of India and Southeast Asia have the greatest variety, including several kinds of hornbills. The islands of the East Indies are home to many colorful birds, such as the pink-necked fruit-dove. The golden-fronted leafbird lives in both India and Southeast Asia. The Himalaya, the great mountain range on India's northern border, hinders the spread of species between India and lands to the north. The northern and eastern foothills of the Himalaya have a number of birds that are found nowhere else. These birds include the Himalayan monal and Lady Amherst's pheasant.



European roller
Coracias garrulus
About 12 inches
(30 centimeters)

Common shelduck
Tadorna tadorna
About 24 inches
(61 centimeters)

Pink-necked fruit-dove
Ptilinopus porphyrea
About 12 inches
(30 centimeters)

White stork
Ciconia ciconia
About 40 inches
(102 centimeters)

Golden-fronted leafbird
Chloropsis aurifrons
7 to 7½ inches
(18 to 19 centimeters)

Rhinoceros hornbill
Buceros rhinoceros
42 to 48 inches
(107 to 122 centimeters)

Nightingale
Luscinia megarhynchos
6 to 6½ inches
(15 to 16.5 centimeters)

WORLD BOOK illustrations
by Arthur Singer

Birds of Africa

Northern Africa lies in the North Temperate Zone and is separated from the rest of the continent by a vast desert, the Sahara. As a result, the birds of northern Africa are more closely related to those of Eurasia than to other African birds. Most of Africa south of the Sahara lies in the tropics. Its rain forests are home to numerous colorful birds, such as the emerald cuckoo. Many species of weaver live in open woodlands. The grasslands of tropical Africa have two of the world's tallest birds, the ostrich and the secretary-bird. Typical water birds of tropical Africa include the shoebill and many ducks, flamingos, herons, and pelicans. The cuckoo-roller and helmetbird are among many birds that live only on Madagascar, a large island off the southeast coast of Africa.

Emerald cuckoo
Chrysococcyx cupreus
8 to 9 inches
(20 to 23 centimeters)

Helmetbird
Euryceros prevostii
About 11 inches
(28 centimeters)

Village weaver
Ploceus cucullatus
About 7 inches
(18 centimeters)

Cuckoo-roller
Leptosomus discolor
16 to 18 inches
(41 to 46 centimeters)

Secretary-bird
Sagittarius serpentarius
Stands about 4 feet
(122 centimeters) tall

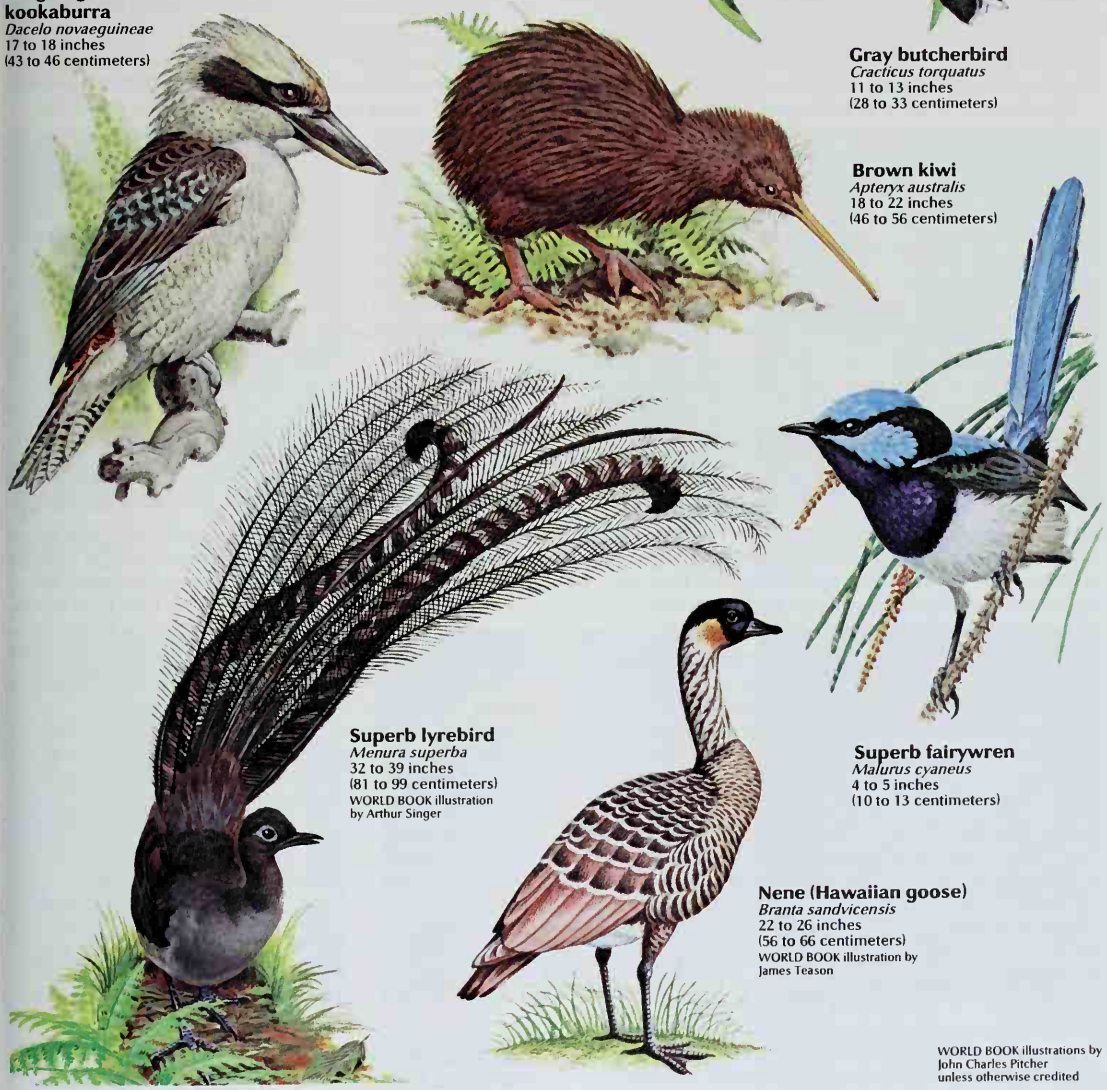
Shoebill
Balaeniceps rex
Stands about 4 feet
(122 centimeters) tall

WORLD BOOK illustrations
by Arthur Singer

Birds of Australia and the Pacific Islands

Three flightless birds—the cassowary, the emu, and the kiwi—are native to the Pacific region. The emu lives in Australia, the cassowary in Australia and New Guinea, and the kiwi in New Zealand. Australia also has many beautiful birds, including the superb lyrebird and numerous kinds of cockatoos, parakeets, and birds of paradise. The gray butcherbird, the laughing kookaburra, and the superb fairywren are common birds of urban areas in Australia.

Hawaii once had many birds—including numerous species of honeycreepers—found nowhere else. Land development, overhunting, and other factors have wiped out or endangered many native Hawaiian birds. Conservation measures have helped save the state bird, the nene, or Hawaiian goose, from extinction.



Laughing kookaburra
Dacelo novaeguineae
17 to 18 inches
(43 to 46 centimeters)

Gray butcherbird
Cracticus torquatus
11 to 13 inches
(28 to 33 centimeters)

Brown kiwi
Apteryx australis
18 to 22 inches
(46 to 56 centimeters)

Superb lyrebird
Menura superba
32 to 39 inches
(81 to 99 centimeters)
WORLD BOOK illustration by Arthur Singer

Superb fairywren
Malurus cyaneus
4 to 5 inches
(10 to 13 centimeters)

Nene (Hawaiian goose)
Branta sandvicensis
22 to 26 inches
(56 to 66 centimeters)
WORLD BOOK illustration by James Teason

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Most small birds live only a few years at the most. Many birds die of hunger, disease, injury, or exposure to bad weather. Numerous others are killed by *predators* (animals that prey on other animals). In spite of all the dangers they face, some birds manage to complete their normal life span. In general, big birds live longer than small ones. For example, albatrosses may live 40 years or more, but wrens are unlikely to live as long as 15 years. Birds generally have a better chance for survival in captivity than in the wild. As a result, the age records for most species are held by birds that were raised in zoos or as pets. The record holders include an eagle owl that lived to age 68 in a zoo and a pet parrot that lived to age 70.

Nearly everything birds do is related to their survival, either as individuals or as a species. To survive as individuals, birds must obtain enough food and water and be able to defend themselves against predators. These activities require skills of movement, such as flying or swimming, and certain communications skills. To survive as a species, each generation of birds must produce and raise offspring.

This section of the article discusses the activities of birds that are important to their day-to-day survival. The section *Family life of birds* deals with the activities of birds that are important to their survival from generation to generation.

How birds get food

Birds have a higher body temperature than mammals. They therefore require more food in relation to their size than do mammals to maintain the higher temperature. In addition, small birds must eat relatively more than large ones because their bodies use up food energy faster. A tiny bird, such as a kinglet, may eat a third of its weight in food each day. A larger bird, such as a starling, may eat only about an eighth its weight. The amount that birds eat also depends on what they eat. For example, a given amount of nectar provides more energy than the same amount of seeds. A nectar-eating bird thus needs less food than a seedeater of the same size. Small birds require so much food that they may spend most of their time eating. Large birds can go several days without food.

Like all other animals, birds must regularly replace the water that their bodies lose. However, birds do not produce such fluid wastes as sweat and urine. They lose only a small amount of moisture in their droppings and when they exhale. Birds therefore require less water than do many other animals. Birds that eat juicy foods, such as nectar or insects, may get all or most of the water they need in their food and may seldom have to drink any. Nearly all birds drink water by scooping it up in their bill, tilting the head back, and letting the drops trickle down the throat.

Kinds of food. Birds mainly eat insects, fish, meat, seeds, and fruits. Each of these kinds of food is preferred by certain species.

Many birds live largely on insects. Insect eaters include creepers, flycatchers, kinglets, nightjars, swallows, swifts, thrashers, titmice, vireos, warblers, woodpeckers, and small hawks and owls. Some insect eaters also feed on spiders and earthworms. Fish-eating birds include cormorants, grebes, herons, kingfishers, loons, ospreys, pelicans, and terns. Many fish eaters also feed on other water animals, such as crabs and snails. Meat eaters, or birds of prey, live on the flesh of reptiles, other birds, and small mammals. The chief birds of prey include caracaras, eagles, falcons, hawks, owls, and vultures. Most of these birds hunt and kill their prey themselves. A few birds of prey eat mainly *carrion*—that is, the decaying flesh of dead animals. Vultures and caracaras are the chief carrion eaters.

Birds that feed mainly on seeds include buntings, finches, grosbeaks, pigeons, and sparrows. Most fruit-eating birds dwell in the tropics, where fruits are plentiful the year around. These birds include hornbills, parrots, tanagers, and toucans. In cooler climates, many birds feed on fruits when available and on insects or seeds the rest of the year. Such birds include catbirds, mockingbirds, robins, and waxwings. Birds also get other food from plants besides fruits and seeds. Honeyeaters and hummingbirds live mainly on nectar from flowers. Sapsuckers often feed on tree sap. Ducks, geese, and swans eat all kinds of vegetable matter, including grass and seaweed.

Although most species prefer a certain food, fish eaters and meat eaters are among the few birds that live on only one kind of food. Most insect eaters also eat seeds or fruits, and most birds that feed on seeds or fruits also eat some insects. A few birds eat almost any food they find, including garbage. These birds include crows, gulls, ravens, and starlings.

Feeding methods. In most cases, the structure of a bird's bill or feet—or of its bill and feet—is adapted to its method of feeding. For example, birds of prey have sharp claws, which they use to seize small animals, and a hooked, razor-edged bill, which they use to tear off the flesh. The section *The bodies of birds* discusses such adaptations.

Some birds have developed highly specialized or unusual feeding methods. Swifts and swallows catch insects in flight by using their long, narrow wings to make fast aerial maneuvers and their extra-wide mouths to capture the insects. Hummingbirds can beat their wings in a circular fashion and so can hover in the air, like a helicopter. Hummingbirds use this skill to hover in front of flowers and collect nectar. They can also fly backward and so back out of a blossom.

Some birds depend on other animals to help them get food. Cattle egrets and cowbirds follow herds of grazing animals and feed on insects startled by the animals' hoofs. Bald eagles, frigatebirds, jaegers, and skuas often steal fish from other birds. Honeyguides, which are found mainly in Africa, live largely on beeswax. The birds cannot get at the wax by themselves. Instead, they perch near beehives and call excitedly. Their call attracts honey-eating mammals, which break open the hives and eat the honey. The birds then feast on the wax and the bee larvae.

How birds move

Birds move from one place to another chiefly by flying. Only a few kinds cannot fly. Some of these flight-

How birds feed

Birds find food in many places—in the air, on the ground, underwater, inside flowers and trees, and even in mud. Their diets include insects, fish, meat, seeds, fruit, and sap. In most cases, the structure of a bird's bill or feet—or of its bill and feet—is adapted to the bird's feeding habits.

© Shelly Grossman, Woodfin Camp, Inc.

A hawk captures a snake. Birds of prey use their sharp claws to seize animals and their razorlike bill to tear off flesh.

Ducrot, Jacana

The swift feeds only on flying insects. The bird's extremely wide mouth enables it to catch insects in the air.

© Jan L. Wassink, Tom Stack & Assoc.

A Bohemian waxwing eats a berry. Its short, broad bill is well adapted to picking berries and other small fruits.

Joseph VanWormer, Bruce Coleman Inc.

The red-legged partridge uses its small but powerful beak to dig up seeds and roots from the ground.

Wayne Lankinen, Bruce Coleman Ltd.

The yellow-bellied sapsucker makes a hole in a tree with its long, pointed bill and then feeds on the sap.

M. D. England, Ardea London

A red-backed shrike has used its strong bill to spear a grasshopper onto the end of a sharp twig.

© Earl L. Kubis, Photographics

The anhinga uses its extremely sharp bill to spear fish. The bird's long, flexible neck and webbed feet help it in fishing.

Eric & David Hosking

The flamingo feeds on the tiny organisms in muddy waters. Its bill filters mud and water from food.

E. R. Degginger

A black skimmer scoops up fish by plowing the water with its bill. The lower part of the bill is shaped like a flat blade.

less birds are cassowaries, emus, kiwis, ostriches, rheas, and penguins. Most birds also can move about on land. The chief exceptions are grebes, loons, hummingbirds, kingfishers, and swifts. The legs of grebes and loons are so far back on the body that the birds cannot walk or even stand. On land, they can barely push themselves along on their belly. However, their legs are ideally positioned for underwater swimming. The legs and feet of hummingbirds, kingfishers, and swifts are suited to clinging or perching but not to walking. These birds can move from place to place only by flying.

Many birds can swim, as well as fly and move about on land. But some of the best swimmers, such as penguins and loons, are handicapped in other movements. Penguins cannot fly, and loons cannot walk.

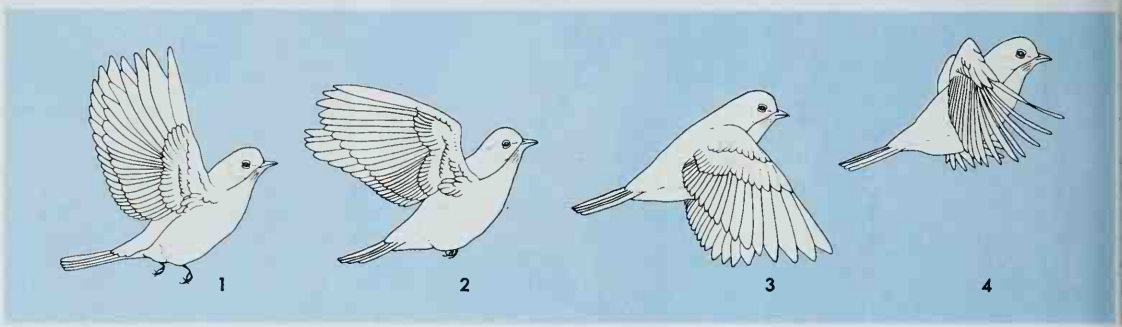
In the air. Airplanes can fly because their wings are shaped like a bird's wings. A bird's wing is curved on top and flat or slightly curved on the bottom. When a wing shaped in this way moves rapidly forward, air flows faster over the curved top surface than over the flatter bottom surface. The faster airflow reduces the air pressure above the wing. Air in a high-pressure area always moves toward a low-pressure area. The air beneath the wing thus moves toward the area of lower pressure above the wing and pushes the wing upward. This upward force, called *lift,* enables birds and airplanes to overcome gravity, rise, and remain airborne.

Birds launch themselves into the air by using their leg muscles to push against a perch or to jump from the ground or water. Some water birds, such as coots and sea ducks, paddle rapidly until they gain enough speed to become airborne. Once birds are in the air, they start flapping their wings. The tips of a bird's wings not only flap up and down but also twist forward on the downstroke. This twisting motion propels the bird forward. The rest of the wing remains level in relation to the flow of air and so provides lift.

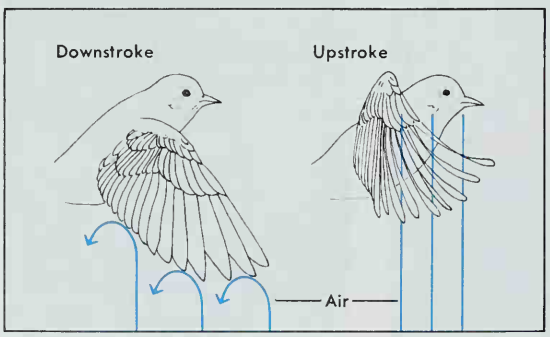
After take-off, some birds continue to fly mainly by flapping their wings. Others combine flapping flight with gliding or soaring. In gliding, birds keep their wings extended and coast downward through the air, using little energy. In soaring, birds use the energy of air movements to propel themselves without having to flap their wings. They may use wind, heated rising air called *thermals*, or the lift of air along a cold front.

The majority of small birds depend on flapping flight. In most cases, their cruising speed averages about 20 to 35 miles per hour (mph), or about 32 to 56 kilometers

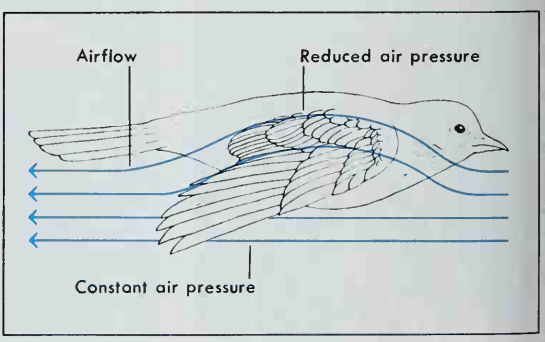
How a bird flies



During a flapping flight, a bird's wings make two kinds of movements. The inner part of each wing moves up and down. The outer part moves in a circle. The circular movement begins on the full upstroke (1) and continues counterclockwise through the start of the downstroke (2), the full downstroke (3), and the start of the upstroke (4). The wing tips push forward on the downstroke, which propels the bird through the air.



The wing feathers overlap on the downstroke so no air can pass through. On the upstroke, the feathers twist open, allowing the air to pass through and making it easier to lift the wing.



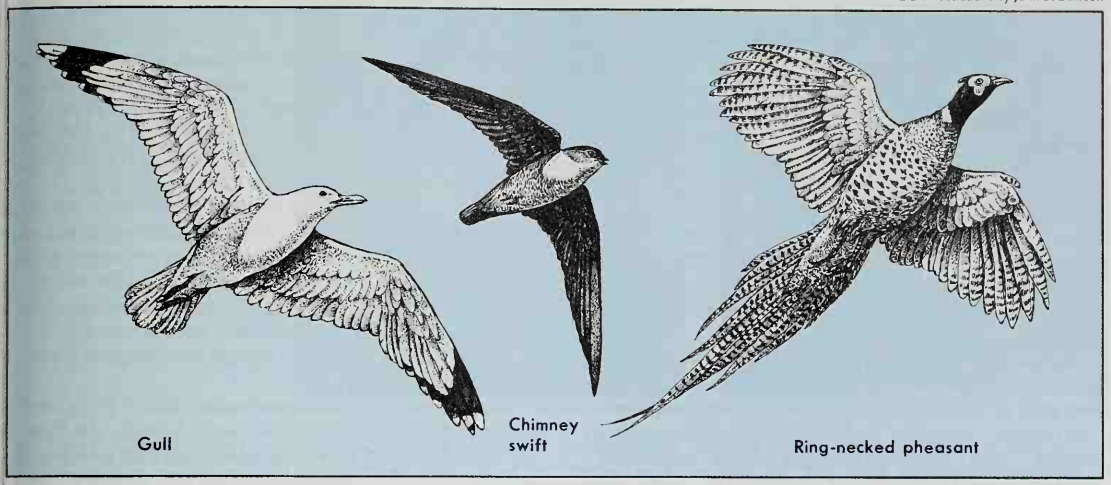
WORLD BOOK diagrams by Jean Helmer

A bird stays aloft because air flowing over the wings drops in pressure. Air pressure under the wings remains the same. High pressure moves toward low pressure, which keeps the bird up.

How wing shape affects flying skills

The shape of a bird's wings relates to the type of flying that the bird does best. Gulls, *left,* and other birds with long, pointed wings excel at soaring and gliding. Most fast fliers, such as swifts, *center,* have narrow, tapered wings. Pheasants, *right,* and most other fowllike birds have short, broad, rounded wings. These birds can take off quickly but can fly fast only a short distance.

WORLD BOOK illustrations by John D. Dawson



per hour (kph). Most fast fliers are large birds with long, pointed wings. The peregrine falcon has been clocked at speeds over 200 mph (320 kph) while diving. Most soaring birds are large ocean birds that have long, pointed wings. Examples of such birds include albatrosses, frigatebirds, gulls, ospreys, shearwaters, and tropicbirds. Ospreys have been clocked soaring at speeds up to 80 mph (129 kph). Soaring land birds include hawks, eagles, and vultures. Unlike the ocean soarers, these soaring land birds have relatively short, broad, rounded wings. Many wild fowl, such as pheasants and quail, also have short, broad, rounded wings. But their wing feathers are particularly stiff. Birds with such wings can take off suddenly and fly at high speeds for a short distance. These birds seldom make long flights, however.

Hummingbirds, kestrels, and terns are among the few kinds of birds that can hover in flight. In addition, hummingbirds are the only birds that can fly backward.

On land. Birds move about on land by running, walking, hopping, and climbing. The big flightless land birds are the fastest runners. Nearly all of them have extremely long legs. Ostriches, the speediest birds on land, can run as fast as 40 mph (64 kph). Some birds that can fly are also swift runners. These birds include bustards, cariamas, and the secretary-bird. Most other birds move more slowly on land.

The majority of birds that nest or feed on the ground

Jacana

The fastest bird on land is the flightless ostrich, *shown here.* Ostriches can run as fast as 40 miles (64 kilometers) per hour. Like most other birds that nest or feed on the ground, ostriches walk and run by moving one foot forward at a time. Most birds that nest in trees hop on both feet when they are on the ground.

walk and run by moving one foot forward at a time, like people. Most species that nest or feed in trees hop about on both feet when on the ground. Some kinds of birds both run and hop. For example, robins often run a short distance and then hop the last few steps before stopping. Some birds are expert climbers, especially those species that climb trees in search of insects. Such birds include creepers, nuthatches, woodcreepers, and woodpeckers. All these birds have short legs and sharp, widely spaced claws, which enable them to cling tightly to the tree while climbing.

In the water. Many species of birds spend much or most of their time in water. They find food and escape from enemies by swimming or diving. Some of these birds swim mainly on the surface of the water. Such birds include albatrosses, gulls, petrels, phalaropes, and shearwaters. The birds use their legs like paddles to propel themselves through the water.

Certain other birds swim underwater as well as on the surface. Most underwater swimmers, such as cormorants, dive from a floating position on the surface. They give a strong kick, point the head downward, and plunge. Some fish-eating birds, including kingfishers and terns, dive into the water from high in the air. They do not swim but bob to the surface and fly away. Most birds use only their legs to swim underwater. However, penguins also use their wings. Grebes can control the depth at which they swim by regulating the amount of air in their lungs and trapped in their plumage. By slowly letting out air, they can gradually submerge themselves until only the head shows above the surface, like a periscope. They can thus swim along unnoticed and watch for enemies at the same time.

How birds communicate

Birds communicate with one another in a variety of ways. Vocal communication by means of songs and calls is the most important way.

Calls and songs. Nearly all birds have a voice and use it to call or sing. A call usually consists of a single sound, such as a squawk or peep. A song consists of a series of notes that follow a fairly definite pattern. About half the known species of birds, including nearly all perching species, produce both calls and songs. The majority of other birds, including most water birds and birds of prey, call but do not sing. Pelicans and some kinds of storks are among the few birds that make no vocal sounds.

Birds use their calls mainly as signals to other birds. Baby birds call in one way to tell their parents that they are hungry and in another way to tell them that they are hurt or frightened. Adult birds use certain calls to signal their mates and other calls to signal the entire bird community. Community calls may warn of approaching danger. Such calls often alert birds of more than one species.

When people think of songbirds, they usually think of canaries, nightingales, and other birds with sweet voices. However, the songs of some birds are not particularly pleasing, at least to human ears. Ravens and waxwings, for example, simply repeat the same unmusical note over and over. In most species of songbirds, only the males sing. They do so chiefly during the mating season. Each male sings from a series of perches that outlines his *territory*—that is, the area he claims and defends as his own. His song, which is called an *advertising song,* has two main purposes. (1) It warns other males of the same species to stay out of the territory. (2) The song attracts a mate. To human ears, the songs of all the birds of a particular species may sound alike. However, each bird's voice sounds different to the other members of the species. Even in a crowded colony, parent birds can single out the voices of their chicks, and chicks recognize those of their parents.

Some birds are talented mimics. They imitate not only the calls and songs of other birds, but also other sounds in their environment, such as dog barks or factory whistles. Mockingbirds and starlings are among the most skillful bird mimics. Certain birds, such as parrots and mynas, become mimics only when kept in captivity. They can then be trained to imitate human speech and even to whistle.

Other means of communication. Some birds communicate by sounds other than vocal sounds. The loud drumming noise that woodpeckers make on tree trunks with their bill is not the same sound they produce when drilling for insects or digging a nest hole. Drumming is their substitute for an advertising song. Each species of woodpecker has its own drumming rhythms. The male ruffed grouse produces a low drumming sound by beating his wings rapidly. This sound, which carries across long distances, also serves as an advertising song. Male and female storks clatter their bills at one another during their courtship.

Birds communicate almost entirely by sounds in habitats where they may have difficulty seeing one another. Such habitats include woodlands and forests. In more open areas, birds also communicate with one another by various kinds of visual displays. For example, they may flash their tail feathers or raise the crest feathers on their head. Like sound communication, sight communication is used in courtship, defending a territory, and signaling danger.

Other daily activities

Birds spend time every day keeping their feathers in good condition. They also sleep and rest every day. In addition, all birds, except perhaps the largest ones, must constantly be alert to avoid enemies.

Feather care. A bird cares for its feathers chiefly by cleaning and smoothing them with its beak, a process called *preening.* A bird uses its feet to preen its head and other hard to reach parts. Most birds *oil* their feathers while preening. A *preen gland* at the base of the tail produces the oil. A bird uses its beak to activate the gland and apply the oil. The oil helps keep the feathers waterproof and flexible.

In addition to preening, most birds bathe frequently. Water birds bathe while swimming. Land birds have less efficient preen glands than do most water birds. Their feathers thus become soaked with water more easily. Most land birds wet their feathers only slightly when bathing and then shake them dry as quickly as possible. Other birds practice a form of bathing called *dusting.*

Protective coloration

The coloring of many birds matches their surroundings and so helps them avoid detection by enemies. For example, the stripes on the throat and chest of an American bittern look like reeds when the bird points its bill upward, *near right.* The feathers of a nesting horned lark blend with the twigs and leaves on the ground, *far right.*

© C. C. Lockwood, Animals Animals

© Brian Hawkes

The birds squat on dusty ground and churn up the dust with their feet and wings until their fluffed-up feathers are thoroughly covered. They then stand up and shake the dust off. The reasons for dusting are not fully understood. It probably helps rid the feathers and skin of lice and other parasites.

Some birds pick up ants with their bill and rub them into their feathers. This process is called *anting.* The ants give off a chemical known as *formic acid,* which probably helps eliminate feather mites, another common parasite of birds. Birds have also been observed using anting motions as they rubbed their feathers with such things as cigarette butts, berries, and grasshoppers.

Sleeping and resting. Most birds search for food during the day and sleep at night. They may also rest and take short naps during the day. Nighttime feeders, such as owls, sleep throughout the day. During the breeding season, most birds sleep in or near their nest. The rest of the time, they sleep on the branches of trees or bushes, on ledges, in holes, or on the bare ground.

Many species of birds sleep while perching on one or both feet. These birds have a locking mechanism in their feet. It makes their toes grip the perch and so prevents the birds from falling. After the nesting season, many kinds of birds sleep together in large groups called *roosts.* Most roosts are in trees, but some are in marshes. Roosts of crows, robins, red-winged blackbirds, grackles, or starlings may consist of thousands of birds.

Some swifts, hummingbirds, and nightjars can lower their body temperature before going to sleep during cold weather. They thus conserve energy while sleeping in much the same way as hibernating mammals.

Protection against enemies. Birds frequently have to protect themselves or their offspring against enemies. Many birds are colored or marked in such a way that they blend with their surroundings. These birds can protect themselves from a predator simply by remaining still and avoiding the animal's notice. This type of concealment is called *protective coloration* (see **Protective coloration**). In other cases, a bird may have to flee or hide—or it may flee and then hide. If all these methods fail, a bird might have to fight.

A bird fights with its beak, legs, or wings—or with all of them—depending on its species. In defending its nest against a predator, a bird often flies at the intruder's head and calls loudly. However, a bird seldom wins a fight against a predator larger than itself. Among some species of ground-nesting birds, a bird may lure a predator away from its nest by dragging one of its wings as if it were broken. An intruder, knowing that a crippled bird is easy prey, may thus be led a safe distance away from the nesting place before the "crippled" bird flies off.

© Charles G. Summers Jr., DPI

A killdeer drags its wing as if it were broken when enemies approach its nest. Because a crippled bird is easy prey, an intruder may leave the nest to pursue the killdeer.

Most small and medium-sized birds are sexually mature by the age of 1 year. Larger birds may take two or more years to mature. They can then mate and raise a family. The mating process begins in spring. At that time, the males of most species select a territory and court a mate. The process continues with the building of a nest and the laying and hatching of eggs. The cycle is complete when the offspring mature and prepare to raise families of their own. Adult birds may raise a new family once or twice a year for as long as they live.

Selecting a territory. A bird's territory may be small or large. Some males claim only the area close to their nest. Others also claim a large feeding area surrounding the nest. After the male selects his territory, he claims it by singing his advertising song. Gulls, penguins, and many other water birds nest in large colonies. But in even the biggest colonies, each male and his mate have their own small territory around their nest. Some birds return to the same nesting site every year.

A male defends his territory chiefly against other males of the same species. In some cases, a warning call or threatening pose is the only defense necessary. In many cases, however, the intruder may refuse to leave without a fight.

Courtship and mating. The relationship between a male and a female bird is known as a *pair bond.* A male and female form a pair bond after a series of *courtship displays* by the male and a favorable response from the female, which is often another display. Each species has its own displays and responses.

The male's advertising song is one of the chief courtship displays among songbirds. Males of other species depend more on bright colors or attention-getting movements and postures. Male peacocks and birds of paradise spread the gorgeous feathers on their lower back. Male frigatebirds have a bright-red neck pouch, which they inflate like a balloon. The courtship displays of many species of birds consist of movements of the head, wings, or other body parts. Cranes, grebes, and herons perform elaborate movements. The female's response may closely resemble the male's display, and so the two often appear to be dancing together.

Although the male courts the female in most species, the reverse is true among phalaropes and a few other kinds of birds. In these species, the females are more brightly colored than the males. The females thus display their plumage to the males, which respond to the females' advances.

By the end of the courtship period, most adult birds have a mate. Most birds mate for one season only. However, a number of others have the same mate for more than a year or for life. These birds include many species of albatrosses, penguins, ravens, storks, and terns. In some species, such as the common yellowthroat and red-winged blackbird, a male may have a pair bond with more than one female at a time. Each female has her own nest within the male's territory.

Building a nest. Many kinds of birds do not build a nest. Most falcons and nightjars, for example, simply lay their eggs on bare ground. Certain other birds nest in hollow trees, in nest boxes, in holes in the ground, or in the abandoned nests of other birds. Such birds include bluebirds, house sparrows, parrots, purple martins, wrens, and some owls. Starlings often chase other birds from their nests and then use the nests themselves. However, most birds build nests, some of which are elaborate structures. In most cases, the female does all or most of the work. If the males help, they chiefly provide building materials.

Most bird nests are bowl- or saucer-shaped structures made of such materials as twigs, grass, and leaves. Birds build such nests on the ground, in bushes and trees, on ledges, and in holes. The nests of the smallest hummingbirds measure only about 1 inch (2.5 centimeters) high. In North America, ospreys build the largest nests, which may be as thick as 6 feet (1.8 meters). Many species of birds cement the building material together with sticky substances. Blue jays and American robins use mud. Hummingbirds and gnatcatchers use sticky threads from spider webs. Swifts use their own saliva, which is thick and gummy. The hardened saliva not only holds the nest together but also cements it to the nesting place, such as the wall of a cave or the inside of a chimney.

Courtship displays

Among most species of birds, the males perform *courtship displays* to attract a mate. A courtship display may involve attention-getting movements, such as the acrobatics performed by the American goldeneye duck, *near right.* The male superb lyrebird makes an elaborate show of his long tail feathers, *far right.*

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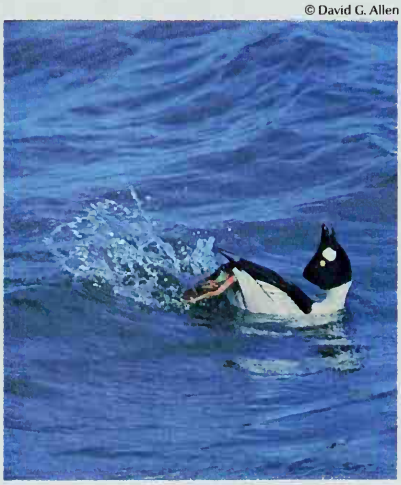

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Some kinds of birds do not build bowl- or saucer-shaped nests. Most woodpeckers and kingfishers nest in holes that they make by using their bill as a digging tool. Woodpeckers dig the holes in dead trees. Kingfishers dig them in banks of sand or clay. Many birds make nests that are completely enclosed except for a small entrance. Weavers of tropical Africa use their bill and feet to weave such nests of grasses and plant fibers. The nests hang from tree branches or reeds. Some kinds of swallows construct enclosed nests of mud cemented to the sides of cliffs, caves, hollow trees, or even houses and office buildings.

Some birds cooperate in building an enormous community nest in which each pair has its own "apartment." Such birds include several species of African weaverbirds, the monk parakeet of South America, and the palmchat of the West Indies.

Laying and hatching eggs. Birds reproduce sexually. In sexual reproduction, a *sperm* (male sex cell) unites with an *egg* (female sex cell) in a process called *fertilization.* The fertilized egg develops into a new individual. The first stage in this development is the formation of an *embryo.* In almost all mammals, the embryo develops inside the body of the female. In birds, the female lays the fertilized egg before the embryo starts to form. After the egg has been laid, it must be incubated for the embryo to develop into a chick.

All eggs laid by a female bird at one time are called a *clutch.* The size of clutches varies widely among different species. Some species lay only one egg at a time. These birds include albatrosses and petrels and many species of auks, penguins, and pigeons. A few birds, including pheasants and grouse, lay clutches of 15 or more eggs. However, most birds lay from 2 to 8.

Kinds of bird nests

Birds build an enormous variety of nests, ranging from simple hollows in the ground to elaborate structures suspended from tree branches. Some of the many kinds of nests are pictured below.

WORLD BOOK illustrations by John D. Dawson

Grebes build their nests on lakes and ponds. They make the nests of weeds and sticks and anchor them to rushes.

Weavers use their bill to weave elaborate, enclosed nests of grass. The nests hang from tree branches.

Barn swallows use pellets of mud to construct nests on the walls of cliffs, caves, and farm buildings.

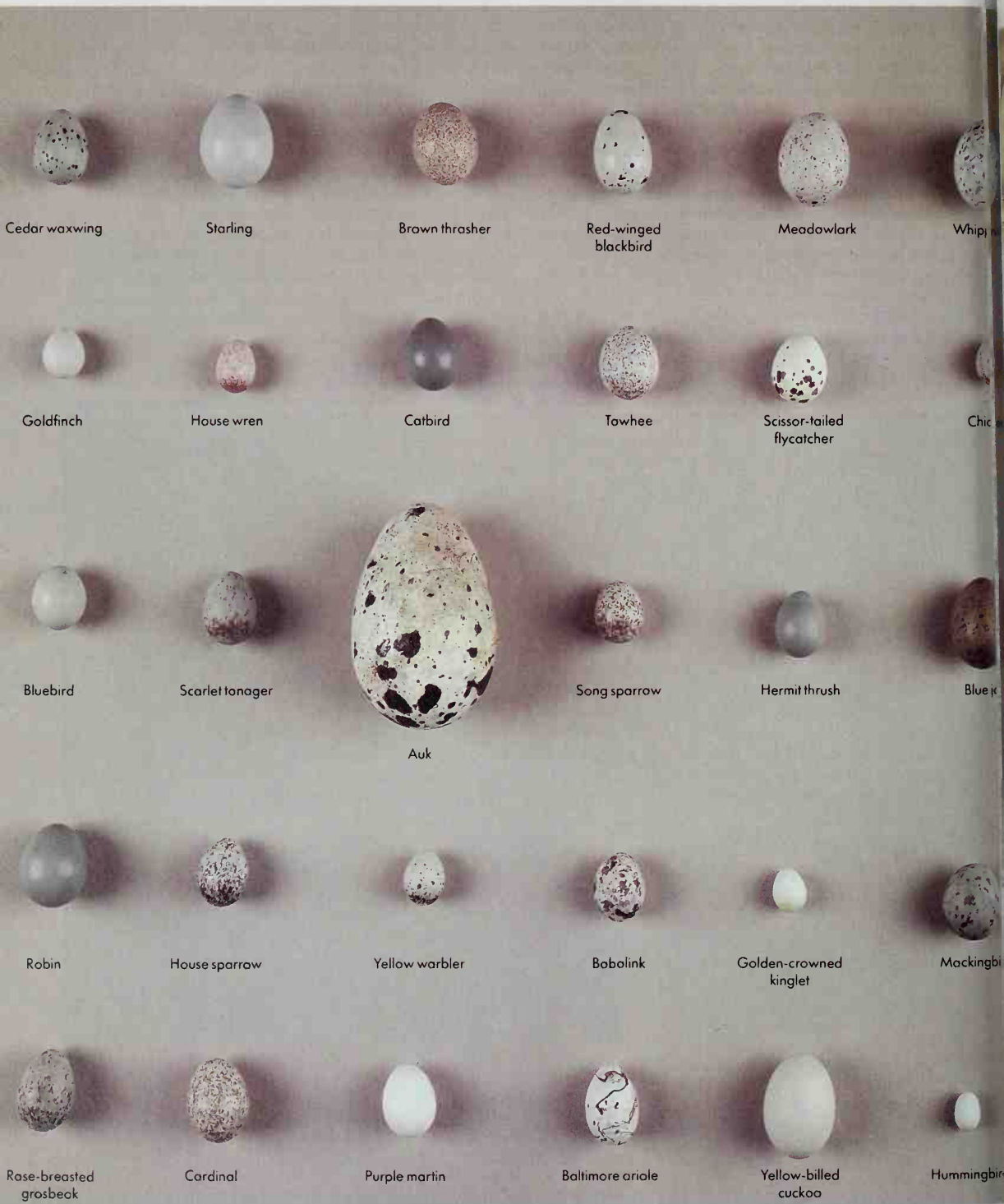
Tailorbirds sew leaves together to form a nest. They use their bill as a needle, and natural fibers as thread.

Woodpeckers make holes in trees for their nests. The holes have little or no lining, except for wood chips.

Killdeers nest in a slight hollow on bare ground. They may line the hollow with gravel or twigs.

Birds' eggs The eggs of most birds have a similar shape but vary greatly in color and size. Most eggs laid in sheltered nests or holes in the ground are white. Most eggs laid in uncovered nests have protective coloring. The eggs pictured below are shown at slightly less than half their actual size.

Field Museum of Natural History, Chicago (WORLD BOOK PHOTO by James Balodimas)



How a chick hatches A European coot chick, shown below, begins to hatch after three to four weeks of incubation. The unborn chick uses the egg tooth on the outer tip of its bill and a strong temporary muscle on the back of its neck to peck a hole in the shell, *left.* The chick presses from the inside with its egg tooth, turning to apply pressure until the shell splits, *center,* and the chick can wriggle out, *right.* As the chick matures, its egg tooth will fall off or gradually disappear.

© Hans Dossenback, Ardea

Birds' eggs differ greatly in size. Hummingbirds lay the smallest eggs, and ostriches lay the biggest. A hummingbird egg weighs less than 1/50 ounce (0.6 gram). An ostrich egg weighs about 3 pounds (1.4 kilograms). Most birds' eggs are shaped like domestic chicken eggs. But the eggs of auks and some other cliffnesting species are sharply pointed at one end. This shape prevents them from rolling off the cliff. Many birds have plain-colored eggs. The eggs of most ground nesters are camouflaged with speckles and other markings.

Nearly all birds incubate their eggs by sitting on them. Among many species, such as pigeons and starlings, the parents take turns incubating the eggs. Among some species, only the female incubates. In a few species, including phalaropes, the male does all the incubating. The incubation period ranges from 10 days in some small songbirds to 80 days in large albatrosses. By the end of this period, the embryo has developed into a chick and is ready to hatch out of the egg. Many chicks have a hard, sharp bump called an *egg tooth* near the tip of the bill. A chick uses the egg tooth to break through the shell. The egg tooth falls off or gradually disappears after the chick hatches. Some chicks have egg teeth at the tips of both halves of the bill.

S. Roberts, Ardea London

An American robin feeds its young. Newborn robin chicks are blind, practically featherless, and so weak-legged they cannot stand. They require constant parental care for up to 15 days.

Caring for the young. Among most species of birds, the newborn chicks are blind, practically featherless, and so weak-legged they cannot stand. Such birds are called *altricial* (pronounced *al TRIHSH uhl*). They include baby hummingbirds, kingfishers, pelicans, swifts, woodpeckers, and all songbirds. In other species, the newborn chicks can see, and they have a covering of fine down and strong legs. These birds are called *precocial* (*prih KOH shuhl*). They include all baby chickens, ducks, geese, ostriches, pheasants, quails, swans, and turkeys. Precocial young can walk from the nest and start to hunt for food a few hours or days after hatching. Altricial young must remain in the nest far longer and be cared for by their parents.

In most cases, the parents of altricial chicks feed them juicy insects or other foods containing much moisture. Gradually, the babies see, grow feathers, and become stronger. They then begin to stand at the edge of the nest and stretch their wings. In time, they start to make short, clumsy flights. All birds fly without being taught. In many cases, however, they need months of practice to become skillful fliers.

In certain birds, other individuals of the same species help the parents raise the young in the nest. This behavior is called *cooperative breeding.* The helpers are often the previous year's young of the same parents. In North America, cooperative breeding occurs in such birds as the acorn woodpecker, Florida scrub jay, groove-billed ani, and red-cockaded woodpecker.

Foster parents. Some birds rely on birds of other species to raise their family. Such birds are known as *brood parasites.* The foster parents are called *hosts.* The brown-headed cowbird and European cuckoo are among the best-known brood parasites. The females of these two species lay their eggs in the nests of songbirds, alongside the eggs of the hosts. The hosts not only hatch the eggs of the brood parasites with their own but also raise the chicks.

The migration of birds is one of the most fascinating and least understood events in nature. Birds are not especially strong. Yet numerous species migrate tremendous distances, often flying many hours or days without stopping. The blackpoll warbler, a North American bird no bigger than a sparrow, flies nonstop nearly 2,500 miles (4,023 kilometers) to its winter home in South America. The journey takes nearly 90 hours.

Many birds migrate farther than the blackpoll warbler, but only large birds fly farther without stopping. Arctic terns are the champions of long-distance migration. They fly about 11,000 miles (17,700 kilometers) from their breeding grounds in the Arctic to their winter home in the Antarctic. The birds return to the Arctic a few months later. They thus travel about 22,000 miles (35,400 kilometers) in less than a year. Many birds migrate enormous distances yet return to exactly the same nesting places every year.

Scientists have made many discoveries about why, where, and how birds migrate. But many questions remain unanswered, and some of them may never be solved.

Why birds migrate. In many parts of the world, the foods that birds eat become scarce during certain seasons of the year. Most birds would starve if they had to remain in such places through the unfavorable season. This situation is especially true of regions with cold, snowy winters. The majority of birds that nest in these regions migrate to warmer climates in fall. They return in spring, when the weather warms up again. Many parts of the tropics have a dry season and a rainy season each year. Food and drinking water may become scarce during the dry season. Many birds avoid such shortages by migrating to moister parts of the tropics at the start of each dry season and returning after it ends. Other birds, which prefer to nest in dry areas, migrate to drier parts of the tropics during the rainy season.

© Leonard Lee Rue IV

Snow geese migrate in enormous flocks. Some snow geese make their summer homes as far north as the Arctic coast of North America and their winter homes as far south as Mexico.

Birds that do not migrate during the unfavorable season are species which can survive on the available food. Most birds that remain in Canada and the northern parts of the United States over the winter live mainly on seeds, tree buds, and dry berries. Such birds include bobwhites, cardinals, grouse, and several kinds of finches and sparrows. Insects are scarce in northern regions in winter. Most insect-eating birds therefore migrate. The majority of those that remain are small birds that live mainly on insect eggs and the developing young of insects. These birds include chickadees, nuthatches, titmice, and woodpeckers.

Although birds migrate to survive, the factors that actually trigger their migrations are much more difficult to explain. For example, many northern species leave their summer home while the weather is still warm and the food supply plentiful. The birds cannot know that the weather will turn cold and that food will become scarce.

Bird migrations are probably regulated by the glandular system. The glands produce chemical substances called *hormones*. Changes in hormone production stimulate the birds to migrate. Among some northern species, hormone production is affected by the length of daylight. As the daylight hours shorten, hormonal changes cause the birds to prepare for their migratory flight south. However, changes in daylight only partly explain the timing of migrations. Different species may depart from the same area at different times. In addition, the same species may not depart at the same time every year. The exact timing of migrations depends not only on the amount of daylight but also on such conditions as the weather and the food supply.

Where birds migrate. The great majority of birds that migrate travel in a generally north-south direction. Most birds that breed in Canada and the northern part of the United States fly south for the winter. Many migrate as far as tropical South America. Some even fly all the way to Argentina, Uruguay, or southern Chile. The seasons south of the equator are opposite those in North America. Therefore, North American birds that migrate to southern South America arrive in time for that region's summer. These birds and many of the native species fly northward at the start of the southern winter. However, no native South American birds migrate to North America. They fly only as far north as the tropics, spend the winter there, and then return south for the summer.

Certain species of migratory birds do not travel in an exact north-south direction. For example, several species that breed in western North America, such as avocets and white pelicans, migrate southeast to winter in Florida. Birds that breed on high mountain slopes may simply move down into the warmer valleys for the winter. In North America, such birds include the common raven, rosy finch, and mountain quail. Some birds make regular seasonal migrations within the tropics, but little is known about these movements.

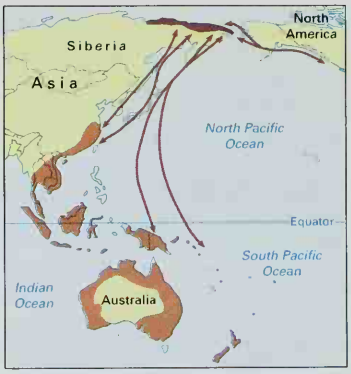
Many species of birds migrate along the same routes. Birds tend to follow such physical features as coastlines, mountain ridges, and river valleys. Heavily traveled routes are known as *flyways*. North America has four main flyways: (1) the Pacific Flyway, along the Pacific coast; (2) the Central Flyway, which follows the Rocky Mountains; (3) the Mississippi Flyway, which follows the Mississippi River; and (4) the Atlantic Flyway, along the Atlantic Coast. However, these flyways are only approximate, and many birds migrate outside them. Scientists have designated these flyways chiefly to divide the continent into zones for administering laws that deal with the hunting of migratory birds.

How birds migrate. Some species of birds migrate in small groups. Other species fly in flocks composed of as many as several million birds. Most small birds travel at night and stop to feed and rest during the day. Most large birds do the opposite. The majority of migrating birds fly at altitudes of about 3,000 to 6,000 feet (914 to 1,829 meters). But some species, including various kinds of shorebirds and geese, have been detected by radar at 20,000 feet (6,096 meters) or higher.

The question of how migrating birds find their way to the same destination every year has long puzzled and fascinated scientists. Scientific research has provided several answers to this question. For example, birds that migrate by day follow various landmarks, such as river valleys and mountain ranges. Experiments have shown that some birds navigate by the stars. Many scientists believe that certain other birds are guided by the earth's magnetic field. However, discoveries like these raise even more puzzling questions. To navigate by the stars or to be guided by the earth's magnetic field, birds must have highly specialized and highly complicated sensory organs. But scientists do not know what these sensory organs are or how they function.

Bird migration The maps below show the summer and winter ranges and the migration routes of three typical birds of the Northern Hemisphere—the bobolink, British yellow wagtail, and sharp-tailed sandpiper. The photographs below the maps picture each of the three birds.

WORLD BOOK maps



The bobolink nests in North America and flies to South America for the winter. The birds migrate along a broad front rather than along well-defined routes.

© Claude Nardin, Jacana

The British yellow wagtail nests in England and winters in Africa. The birds follow a coastal route when flying south and an inland route when flying north.

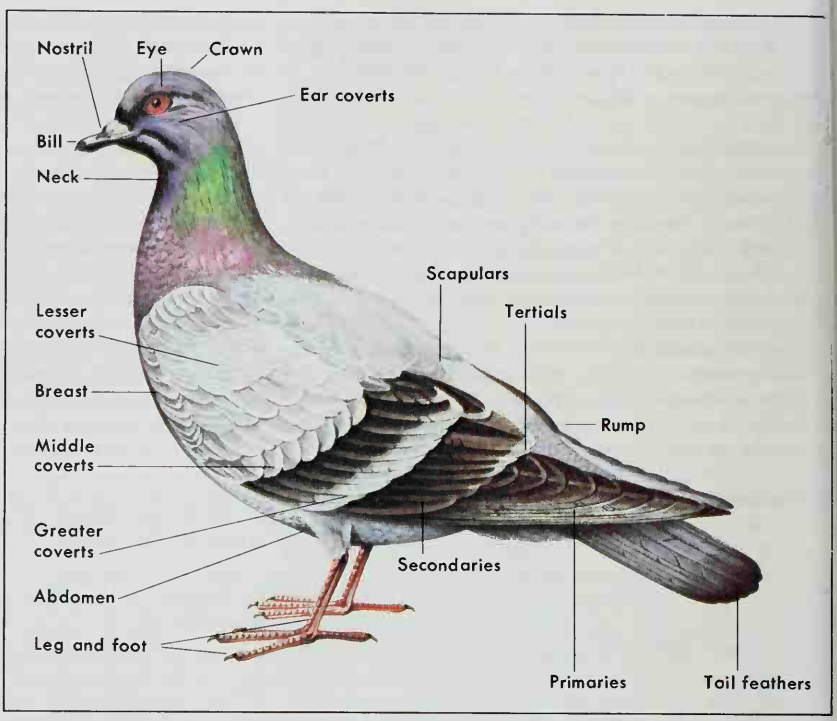
Kevin Carlin, Ardea, London

The sharp-tailed sandpiper breeds in Siberia. The birds migrate along a variety of routes to such far-flung places as Australia and western North America.

Don Hadden, Ardea, London

The external features of a bird

The drawing at the right shows the main external features of a typical bird, the domestic pigeon. Feathers are the most prominent feature. They cover all the body except the eyes, bill, legs, and feet. The feathers grow in groups, such as the *primaries, secondaries, scapulars, tertials,* and various sets of *coverts.*



WORLD BOOK illustration by Venner Artists, Ltd.

The bodies of birds are adapted for flying. Even such flightless birds as penguins and ostriches have some features of their flying ancestors. The skeleton, feathers, and internal organs are all exceptionally lightweight. The body as a whole is streamlined. Birds' bodies differ mainly in size and in the adaptations for getting food, avoiding enemies, and attracting a mate.

External features

The most striking external feature of a bird is its feathers. Feathers cover all the main parts of a bird's body except the eyes, bill, legs, and feet. In some species, including some owls, even the legs and feet have feathers.

Feathers. Birds have about 940 to 25,000 feathers, depending on the species. Most feathers have a stiff central *shaft,* on each side of which is a flat *vane.* The vane consists of hundreds of slender parallel branches from the shaft. These branches are called *barbs.* The largest feathers are the long *flight feathers* of the wings and tail. The flight feathers near the tip of the wing are called *primaries.* Those closer to the body are known as *secondaries.* A layer of smaller feathers, called *coverts,* covers the base of the flight feathers.

In addition to vaned feathers, some birds have *down feathers* or *plumes* or both down feathers and plumes. Most down feathers have a short shaft and soft, fuzzy barbs that are not connected into vanes. Many water birds have a thick coat of down under the vaned feathers. Plumes are generally long feathers with flexible shafts and barbs. They may grow from different parts of the body and are used in courtship displays.

In many species of birds, the male's feathers are more brightly colored than the female's. In a few species, the females are more colorful. In other species, the male and female look alike.

Birds shed their feathers at least once a year and grow a new set. This process, called *molting,* generally occurs after the breeding season. Most birds that molt twice a year have a different appearance during different seasons. The majority of these birds, including grebes, loons, and scarlet tanagers, are brightly colored in spring and summer and dull in fall and winter. In some species, such as bobolinks and many ducks, only the males alternate between a colorful and dull phase.

Bills. The bills of birds differ mainly according to how the birds feed. Finches, grosbeaks, and most other seed-eating birds have a hard, cone-shaped bill, which they use like a nutcracker. Many fruit eaters also have a cone-shaped bill. But these birds use the sharp point of the bill to pierce the skin of oranges and other thick-skinned fruits. Woodpeckers have a chisellike bill, which they use to bore into trees in search of insects.

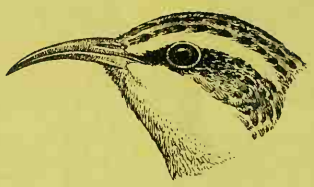
Many ducks eat the plant matter that floats on bodies of water. These birds have an exceptionally broad bill with hundreds of tiny filters along the edges. The broadness of the bill enables the birds to take big mouthfuls of water. The filters along the edges of the bill trap the food particles and let the water drain away. Most fish-eating birds, such as herons and terns, have a long, pointed bill, which they use to spear fish. Pelicans and a few other fish eaters use their unusually large bill to scoop fish from the water. Some land birds, such as hornbills and toucans, have a large, brightly colored bill. Most hornbills and toucans are fruit eaters, however.

Types of bills

The bills of birds vary according to what they eat and their feeding methods. The drawings below illustrate the widely different bill adaptations among six kinds of birds. Birds also use their bills in nest building and self-defense as well as in feeding.

WORLD BOOK illustrations by John D. Dawson

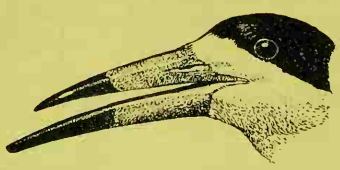
Chisel bill
Woodpeckers hunt insects by drilling into trees with their chisellike bill.



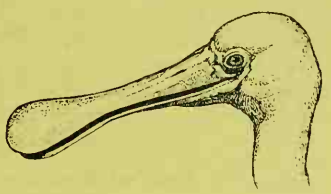
Prober bill
Brown creepers use their bill to probe the bark of trees for insects.

Cracker bill
Grosbeaks have an unusually strong bill, which they use to crack seeds.

Trap bill
The nighthawk's bill opens wide, trapping insects in midair.



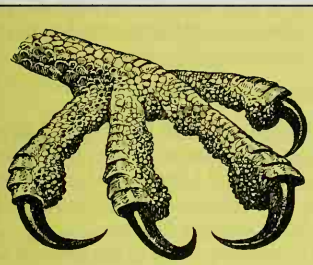
Scoop bill
Skimmers use the bottom half of their bill to scoop fish from the water.



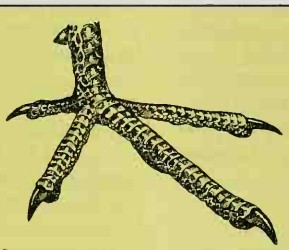
Detector bill
A spoonbill sweeps its bill back and forth through the water to find prey.

Types of feet

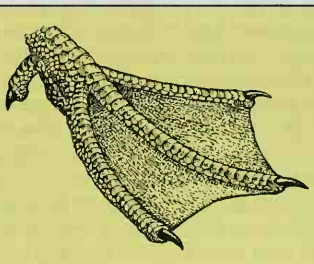
Most birds have four toes on each foot, and all birds have a claw at the tip of each toe. However, the arrangement and size of the toes and the size and shape of the claws vary according to the ways of life of different species. These drawings show six of the most common variations.



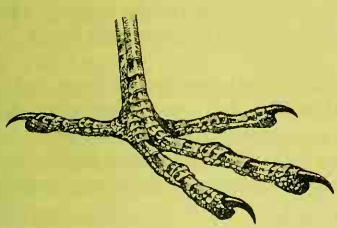
Grasping foot
Ospreys use their large, curved claws to snatch fish from the water.



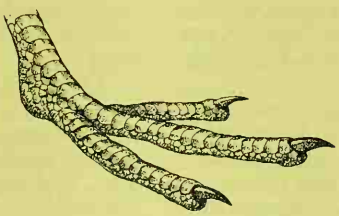
Scratching foot
Pheasants and other birds that scratch the soil for food have rakelike toes.



Swimming foot
Ducks and other web-toed swimming birds use their feet like paddles.



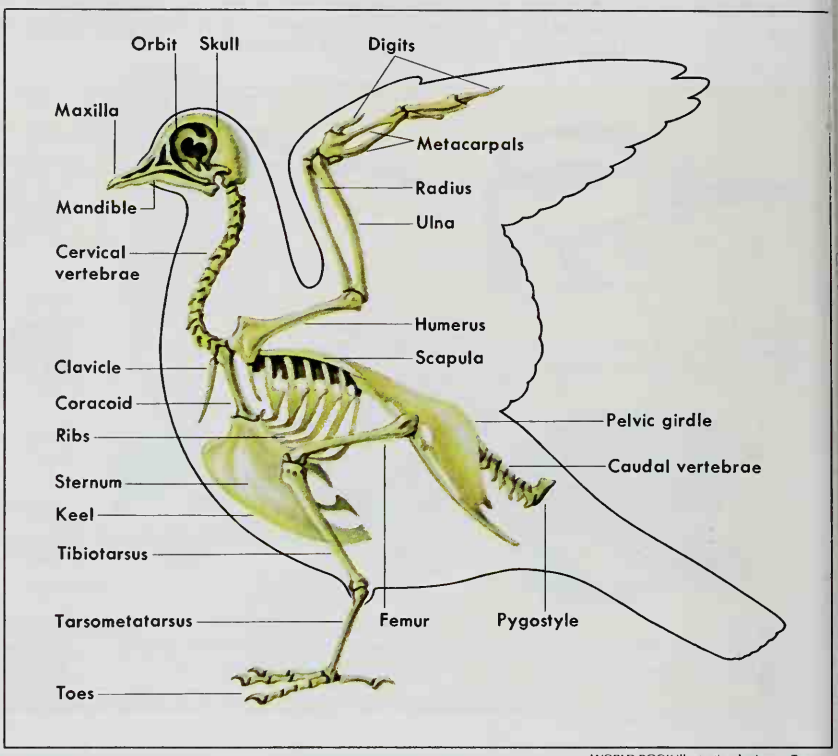
Perching foot
Robins have a long hind toe, which helps them grip a perch tightly.



Running foot
Killdeers and many other fast-running birds have three toes instead of four.

Climbing foot
A woodpecker's hind toes enable it to climb without falling backward.

The skeleton of a bird
A bird's skeleton is both lightweight and strong. It is lightweight because many of the bones are hollow. The skeleton is strong because many of the bones are *fused* (joined together).This drawing shows the skeleton of the domestic pigeon.



WORLD BOOK illustration by James Teason

The huge size and bright colors of the bill are apparently unrelated to the method of feeding. They probably serve mainly for courtship display.

Legs and feet. Although all birds have two legs and two feet, the size and structure of the limbs differ greatly among various species. Birds that spend most of their time in the air have exceptionally short legs. The legs of most tree climbers are also shorter than the average. On the other hand, most wading birds and fast runners have especially long legs.

The great majority of birds have four toes on each foot. Among most species, including all songbirds, three toes point forward and one points backward. A perching bird steadies itself by curling the hind toes around a branch or other perch. Some birds that are good climbers, including parrots and woodpeckers, have two toes pointing forward and two pointing backward. The hind toes help provide an extra grip for the birds as they climb. Emus and most other flightless, fast-running birds have three toes on each foot. The ostrich is the only two-toed bird.

Many swimming birds have webs of skin connecting their toes. The webbing enables the birds to use their feet like paddles. In such birds as ducks and gulls, the webbing connects only the three front toes. Cormorants, pelicans, and related birds have all four toes connected by webs. Instead of webbing, coots, grebes, and phalaropes have broad, paddlelike toes. Gallinules and screamers are also good swimmers, but their feet differ little from those of four-toed land birds.

All birds have a claw at the tip of each toe, but the claws are not equally prominent in all species. Birds with large, sharp, curved claws include birds of prey and birds that cling to vertical surfaces, such as creepers, nuthatches, swifts, and woodpeckers. Most running birds have short, blunt claws.

Skeleton and muscles

A bird's skeleton is lightweight but strong. Many bones that are separate in mammals are *fused* (joined together) in birds. The fused bones give the skeleton exceptional strength. The skeleton is lightweight chiefly because many of the bones are hollow.

The wings of a bird correspond to the arms of a human being. Each wing has three main parts: (1) the outermost part, or *hand;* (2) the middle part, or *forearm;* and (3) the part nearest the body, or *upper arm.* The primary flight feathers are attached to the hand. The secondary flight feathers are attached to the forearm. The upper arm carries the muscles that move the bird's wing.

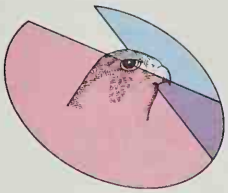
In birds that fly, the largest muscles are those that move the wings. Most birds have strong leg muscles, but these muscles are especially well developed in fast runners. Small muscles at the base of each feather enable a bird to maneuver its feathers, fluff them, or display them.

Senses

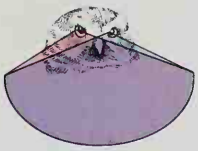
Birds have keen senses of sight and hearing. However, their senses of smell, taste, and touch are less well developed.

How birds see

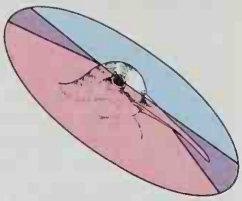
The eyes of falcons and most other species of birds are on the sides of the head. Each eye thus sees a separate view, unless both eyes are looking straight ahead. Birds that see in a different way include owls and woodcocks.



Falcons see less with both eyes than with each eye separately. The two fields of vision overlap in a small area.



Owls are among the few birds whose eyes are on the front of the head. Both eyes see the same view at all times.



WORLD BOOK illustrations

Woodcocks have their eyes so far back on the head that their fields of vision overlap in back as well as in front.

Sight. Birds have relatively large eyes. They can see colors as well as human beings can. Unlike our eyes, however, the eyes of almost all birds are on the sides of the head. Because both our eyes face forward, we have *binocular vision*—that is, both eyes see the same view. Most birds have binocular vision only where the fields of vision of both eyes overlap directly in front of them. They have *monocular vision* on either side—that is, the eye on each side of the head sees a separate view. Owls, woodcocks, and penguins are the chief exceptions. Owls are among the few birds with eyes on the front of the head. Owls therefore have binocular vision at all times. The eyes of woodcocks are set so far back on the head that the birds have binocular vision behind as well as in front. The eyes of penguins are set in the head in such a way that the birds have monocular vision only.

Some birds can see even better under certain conditions than we do. Birds that are most active in the evening or at night have eyes that are extremely sensitive to light. Their vision in dim light is far superior to that of human beings. Diving birds seem to be able to focus their eyes equally well in the air and underwater. These birds can change focus much more rapidly than people can.

Hearing. Birds have an ear on each side of the head, though it is not visible. The outer ear is simply an opening into the inner ear and is covered with feathers. Most birds probably hear at least as well as people. Some species have extremely sensitive hearing.

A few birds depend more on their sense of hearing than on their sense of sight. These birds include the guacharo, or oilbird, of South America and several species of swiftlets that live in the East Indies. The birds dwell in dark caves and use a system called *echolocation* to navigate. As they fly in the dark, they make clicking sounds in the throat. The sounds bounce off the cave walls, creating echoes. The birds can tell from the echoes exactly how close they are to the walls and so can avoid hitting them.

Smell, taste, and touch. Although most birds probably have a sense of smell, only a few species are known to depend on it heavily. Kiwis are nearly blind and use their sense of smell to locate food. Kiwis are the only birds with nostrils at the very tip of the bill. Honeyguides locate beehives by the smell of the beeswax.

Scientists know little about the senses of taste and touch in birds. All birds have a tongue with taste buds. But they have far fewer taste buds than do mammals, and so their sense of taste is probably less developed. The eyes of birds are extremely sensitive to touch. If a speck of dust or other particle touches the eyeball, a special eyelid called a *nictitating membrane* sweeps across the eye and wipes it off. Some birds, such as sandpipers and woodcocks, also have a keen sense of touch at the tip of their bill. They use their bill to probe the soil for insects and worms.

Systems of the body

The internal organs of birds, like those of other animals, are grouped into systems. The major systems include the respiratory, digestive, circulatory, nervous, and reproductive systems.

The respiratory system in birds, as in mammals, serves to transfer oxygen from the air to the bloodstream. Birds breathe air in through their nostrils and mouth. The air travels to the lungs, where the bloodstream absorbs the oxygen.

Respiration has another important purpose in birds. Unlike mammals, birds lack sweat glands and thus cannot cool themselves by perspiring. Instead, birds have thin-walled pouches called *air sacs* between various organs of the body. The sacs are connected to the lungs. As a bird inhales air, some of it passes from the lungs into the air sacs. This air cools the organs and prevents them from overheating.

The body temperature of birds averages about 106° F. (41° C), or more than 7° F. (4° C) higher than the average body temperature of people.

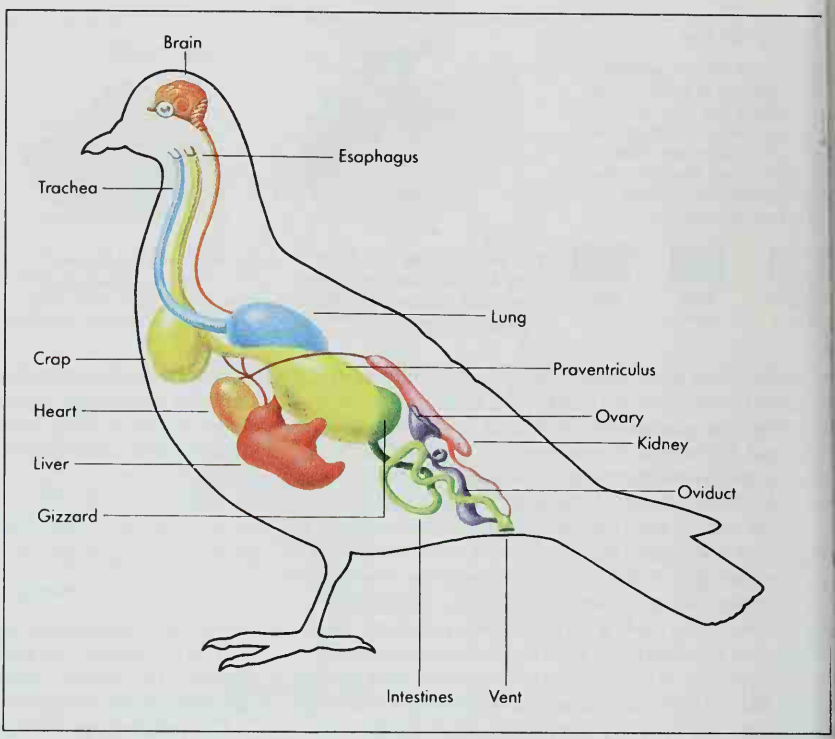
The digestive system. Unlike almost all mammals, birds have no teeth and so cannot chew their food. They must either cut it up with their bill or swallow it whole. A bird's digestive system consists mainly of the esophagus, stomach, and intestines.

The esophagus is a tubelike organ with expandable walls. Food passes into it from the mouth. In mammals, the esophagus leads directly into the stomach. In many birds, the esophagus has a baglike swelling called the *crop*. Birds can store food in the crop until there is room for it in the stomach. Birds also store food in the crop to carry to their babies.

Food passes from a bird's esophagus or crop into the stomach. In most birds, the stomach has two parts. In the first part of the stomach, digestive juices are added to the food. The second part of the stomach, which is called the *gizzard,* has thick, muscular walls that grind food. This process replaces chewing. Many birds assist

The internal organs of a bird

This view of a female domestic pigeon shows the chief internal organs of the typical bird. Most of these organs are also found in mammals. The chief exceptions are the *crop, proventriculus,* and *gizzard.* The crop is an extension of the esophagus. It stores food until there is room for the food in the proventriculus. The proventriculus and gizzard together make up a bird's stomach. Digestive juices are added to food in the proventriculus. The gizzard grinds the food into pieces small enough to be fully digested.



WORLD BOOK illustration by James Teason

the grinding process by swallowing gravel or other coarse materials.

Food passes from the stomach into the small intestine, where the nutritious matter is absorbed into the blood. The remaining waste matter moves into the large intestine. Nearly all or most of the water in the wastes is absorbed by the wall of the intestine. Birds have an opening called the *vent* at the rear of the body. The vent is connected with the digestive system, with tubes that drain wastes from the kidneys, and with the reproductive system. All wastes pass out of a bird's body through the vent.

The circulatory system distributes blood throughout a bird's body. The system consists of the heart and blood vessels. The heart of a large bird, such as an ostrich, beats at about the same rate as the human heart—that is, about 70 times a minute. The rate is much faster in small birds. A hummingbird's heart beats more than 1,000 times a minute. The main blood vessels in birds, as in all other vertebrates, are *arteries* and *veins.* Arteries carry blood from the bird's heart to other parts of the body. The blood returns to the heart through the bird's veins.

The nervous system of a bird is similar to that of other vertebrates. It consists basically of the brain and nerves. The nerves carry messages from the senses to the brain and from the brain to the muscles.

A bird's brain is small compared with a mammal's. But the lower part of the brain, the *cerebellum,* is relatively larger in birds than in mammals. The cerebellum is the part of the brain that regulates balance and movement and coordinates the muscles birds use to fly. The upper part of the brain, the *cerebrum,* is far bigger and better developed in mammals than in birds. The cerebrum is the part of the brain that controls learning. A few birds, such as crows and parrots, have a bigger cerebrum than do other birds their size. This characteristic probably helps explain why these birds can learn to "talk" or do tricks.

The reproductive system. The male sex organs in vertebrates are called *testes.* The female organs are called *ovaries.* The testes and ovaries produce sex cells. The testes produce sperm, and the ovaries produce eggs. In birds, the testes lie inside the body, just beneath the backbone. Throughout most of the year, the testes are extremely small. They start to grow larger just before the start of the breeding season. About the same time, a female's eggs also start to enlarge and accumulate yolk. When an egg reaches a certain stage of development, it passes from the ovary into a tube-shaped organ called the *oviduct.* About this time, mating takes place.

Most birds mate by pressing their vents together. Sperm cells quickly pass from the male's vent into the female's. One or more sperm cells may unite with one or more egg cells in the upper part of the oviduct. Such a union produces a fertilized egg, or *zygote.* The zygote, which is on the surface of the yolk, continues down the oviduct. Glands in the middle part of the oviduct deposit *albumen* (egg white) around the yolk. Glands in the lower part then produce the shell around the albumen. The egg is then laid. The zygote develops into an embryo as the egg is incubated. The yolk and albumen provide food for the embryo.

The scientific study of birds, which is called *ornithology,* began during the 1700's. Organized efforts to protect birds started somewhat later. As late as the mid-1800's, however, there were no laws to help stop human beings from killing or capturing almost any bird they pleased.

By the late 1800's, more and more people realized that something had to be done to prevent the terrible destruction of birds. The American Ornithologists' Union, which was founded in New York City in 1883, formed a committee on bird protection in 1886. Also by the late 1800's, bird lovers throughout the United States had formed local organizations to help protect birds. These groups were called *Audubon Societies* in honor of the American naturalist and painter John James Audubon. In 1905, the local groups united to form the National Association of Audubon Societies. The association was renamed the National Audubon Society in 1940.

The American Ornithologists' Union and the National Audubon Society have led efforts to protect birds in North America. Today, the United States and Canada have strict bird protection laws. The Fish and Wildlife Service administers such laws in the United States. The Canadian Wildlife Service administers them in Canada. Both countries also have many refuges for birds. Thousands of Americans and Canadians take an active interest in birds, and bird watching has become a popular hobby.

Bird watching. Binoculars are the most important bird-watching equipment. Without binoculars, it is often hard or impossible to see birds clearly at a distance. Most bird watchers use illustrated guidebooks, which are called *field guides.* These books help them identify unfamiliar species. People watch birds in two principal ways: (1) by attracting various species to a particular location and (2) by taking field trips to the natural habitats of birds.

Attracting birds. A yard or garden with a variety of trees, shrubs, and flowers will normally attract birds. Trees and shrubs provide them with such foods as seeds and berries as well as with shelter and nesting places. Flowers attract insects that birds like to eat. Birds need water for drinking and bathing. They are especially drawn by dripping water from a hose or outdoor faucet. Water in a birdbath or shallow dish will also attract them.

Birds can usually find all the food they need in summer. In areas with cold winters, however, birds that do not migrate may have difficulty finding food after a heavy snow or freezing rain. People can help by putting out food for birds that may need it. Many people feed birds in winter as a hobby. However, it is extremely important to continue putting out food daily throughout the winter and early spring after the practice has been started. Birds may become used to finding food in certain spots, and they may starve if the feedings are stopped.

Most winter residents are primarily seedeaters. A variety of bird seed can be bought at most grocery or feed stores. Numerous winter residents like *suet* (hard animal fat). Suet provides the extra food energy that many birds need during cold weather. Many birds will also eat table scraps, such as leftover egg, toast, lettuce, or potato. Some birds like to eat from a shelf or tray that has been placed above ground level. Such a bird feeder can be bought or easily built. Most public libraries have books or pamphlets that explain how to build different kinds of bird feeders.

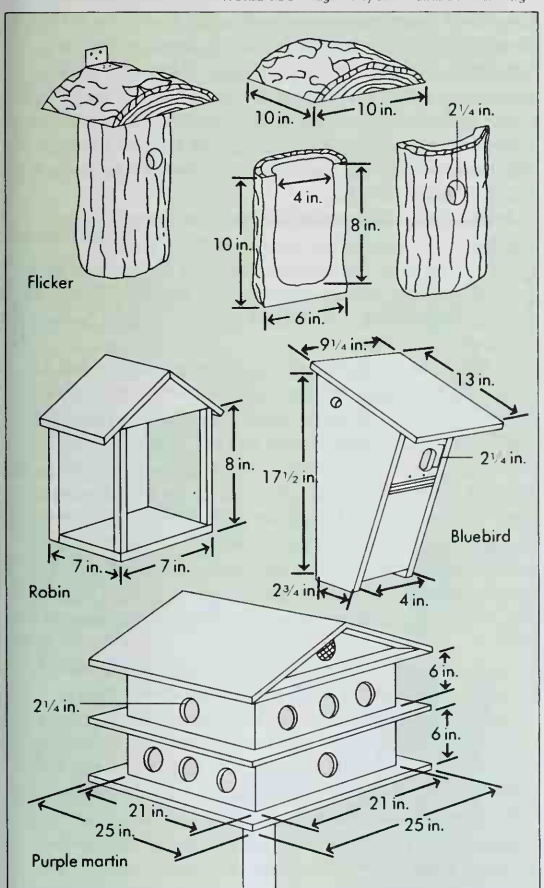
A few kinds of birds will nest in birdhouses or nesting boxes. These birds include bluebirds, chickadees, purple martins, titmice, and wrens. The structures should be placed outdoors before the spring mating season begins. They should be located in a spot that is shaded from the sun during the hottest part of the day. As in the case of feeders, a homemade birdhouse or nesting box can be as good as one that is purchased. Most public libraries can provide detailed instructions for building birdhouses.

Field trips. The best way to see and study a wide variety of birds is in the field. Numerous bird watchers travel to remote areas to see unfamiliar species. However, many such birds can also be seen in nearby parks

How to build a birdhouse

The diagrams below show the designs and dimensions for four birdhouses. Choose the design for the type of bird you wish to attract. In early spring, place the birdhouse in a shady spot.

WORLD BOOK diagrams by Steven Liska and Mark Virgin



Jeff Foott, Bruce Coleman Ltd.

Birdbanding helps scientists study the life and migration routes of birds. A Cassin's auklet chick, *shown here,* is being banded. Whenever the bird is recaptured, the number on the band will tell scientists where it was banded or last captured.

and nature preserves. It is best to make field trips alone or with a small group. Birds may be frightened away by a large group of people.

Many bird watchers take part in periodic counts, or censuses, of the birds in their area. The National Audubon Society sponsors annual censuses of all the bird species in the United States. Bird censuses help conservation officials determine which species may need special protection.

Birdbanding is the placing of metal identification bracelets, or *bands,* on the legs of wild birds. This practice enables scientists to trace the life history of individual birds. The life histories, in turn, provide valuable information about the migration routes and life spans of different species.

The U.S. Fish and Wildlife Service regulates all birdbanding in the United States. The Canadian Wildlife Service regulates it in Canada. Only people licensed by the U.S. or Canadian agency may band birds in either country. The two agencies also issue all bird bands and keep records of all the birds banded in both countries. Each band bears a number and the name and address of the U.S. agency. No two bird bands have the same number, and so all banded birds can easily be individually identified.

Banders use nets or cagelike traps baited with food to capture birds for banding. Baby birds can often be captured by hand. The bander attaches the band around the bird's leg with a pliers. The bander also records the number of the band, the date, and the bird's species, sex, size and weight, and approximate age. This information is sent to a computer center operated by the U.S. Fish and Wildlife Service, which sends copies of its records to the Canadian agency. If a banded bird is recaptured, the capturer sends its number to the address shown on the band, along with the date and place of capture. Anyone who finds a dead banded bird should mail the band to the address on the band along with information about when and where the bird was found.

Some birds are banded with several plastic bands of various colors in addition to the numbered metal band. Different color combinations identify the individual birds and make it possible to recognize them from a distance without being captured. For some experiments, birds are fitted with a tiny radio transmitter on the tail or back. The radios send out signals that enable scientists to track the birds.

Bird refuges. The spread of farms, towns, cities, and highways has destroyed the natural habitats of many birds and other animals. To help remedy this problem, a number of countries have set aside areas of land as refuges for birds and other wildlife. The United States and Canada have many such areas. Some of the refuges are publicly owned. In the United States, the federal government owns and operates more than 450 wildlife refuges as part of the National Wildlife Refuge System. The refuges cover a total of over 90 million acres (35 million hectares). The Canadian government owns and operates about 120 wildlife refuges. Other refuges in both countries are owned or leased by private conservation groups. Large public parks and forests also serve as bird sanctuaries.

Wildlife refuges play an especially important role in protecting ducks, geese, and other migratory wild fowl. Some refuges also provide homes for endangered species. Land in state forests in Michigan has been set aside to protect the only known breeding areas of the rare Kirtland's warbler. The nesting area of the nearly extinct whooping crane is reserved as part of Wood Buffalo National Park in northwestern Canada. Whooping cranes winter in Texas along the coast of the Gulf of Mexico. This area is reserved for them as part of the Aransas National Wildlife Refuge.

Protective laws and treaties. The United States, Canada, and many other countries have laws to protect birds within their borders. However, a large number of species migrate across international borders. These migrating birds can be protected only by treaties between the nations involved.

In 1916, the United States and Canada signed the Migratory Bird Treaty, the first bird protection treaty in North America. The treaty went into effect in Canada in 1917 and in the United States in 1918. Under the terms of the treaty, the two countries pledge to prohibit the hunting and capture of all songbirds that migrate across their borders. They also agree to regulate the hunting of all game birds that migrate between the two countries and to prohibit the sale or purchase of migratory birds and their nests, eggs, and feathers. The United States and Mexico signed a similar bird protection treaty in 1936.

Since the mid-1900's, people throughout the world have become increasingly concerned about international trade in rare birds and other animals or in their skins or feathers. More and more countries, including the United States and Canada, have forbidden the importing and exporting of such items. In 1973, representatives of 80 nations drafted a treaty to regulate international trade in endangered species. So far, the United States, Canada, and more than 100 other nations have ratified the treaty.

Most scientists believe that birds and mammals both *evolved* (developed gradually) from reptiles. However, scientists know far more about the evolution of mammals. Scientists learn about the development of animals by studying fossils, especially the remains of bones. Mammals have teeth and relatively hard bones and so have left behind many well-preserved fossils. The bones of birds, however, are extremely fragile. As a result, fewer bird fossils have been preserved, and most of these are of large birds. This section discusses the theory that most scientists believe best describes the development of birds.

The first known birds. At some point in the evolution of birds from reptiles, there must have been various kinds of birdlike reptiles. Such creatures would have structures intermediate between reptile scales and bird feathers. However, no fossil of any such birdlike reptile has yet been found.

The earliest bird fossils belong to a *genus* (group) called *Archaeopteryx*. *Archaeopteryx* lived about 140 million years ago. It resembled a reptile in many respects. However, it had feathers like those of modern birds. The first *Archaeopteryx* fossils were found during the mid-1800's. Altogether, seven fossils—six partial skeletons and a single feather—have been found. Six of the fossils were found in limestone beds in southern Germany. The best-preserved of these specimens shows the imprint of almost all the skeleton plus the flight feathers.

In 1988, scientists found a large *Archaeopteryx* fossil in a private collection in Bavaria. The specimen, which is about the size of a raven, had been misidentified as the skeleton of a small dinosaur. Unlike modern birds, *Archaeopteryx* had teeth, a reptilelike tail, and three claws on each wing. It may have used these claws to climb trees. Scientists believe *Archaeopteryx* could fly, but probably only weakly.

The next well-preserved bird fossils date from about 90 million years ago. The best-known birds of that time are *Hesperornis* and *Ichthyornis*. Both were water birds that lived in what is now the Midwestern United States. At that time, a large inland sea covered most of the region. *Hesperornis* and *Ichthyornis* almost certainly ate fish. Like *Archaeopteryx*, both had teeth. But in other ways, they looked more like modern birds than did *Archaeopteryx*. *Hesperornis* somewhat resembled a modern grebe or loon. It could not fly but was a strong underwater swimmer. *Ichthyornis* could fly and looked somewhat like a small gull.

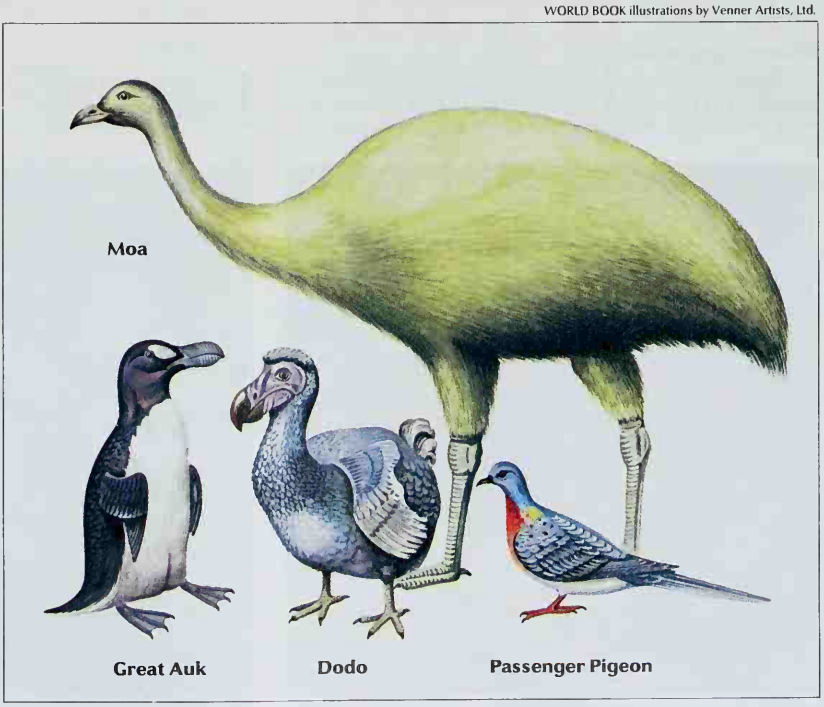
The first modern birds appeared by about 65 million years ago. Unlike earlier birds, they resemble species that still exist. Most of them were toothless water birds. They included the ancestors of today's ducks, flamingos, and pelicans. The ancestors of most other modern birds evolved between about 65 million and 1 $\frac{3}{4}$ million years ago. They included the first falcons, ostriches, owls, penguins, and wild fowl. About 2 million years ago, the Pleistocene Ice Age began. During the Ice Age, there were several periods when great glaciers covered much of Europe and North America. By the time the last glacier retreated—about 10,000 years ago—almost all of today's species of birds had arisen.

Extinct birds include all the species that died out before the Ice Age. Some species also became extinct during the Ice Age, probably because of the great climatic changes brought about by the advance and retreat of the glaciers. However, the rate at which these early spe-

Extinct birds

About 80 species of birds have died out since the 1600's. Some became extinct as a result of natural causes. But human beings killed off the great majority through such practices as overhunting, destroying their habitats, and introducing into their habitats animals that preyed on the birds. The drawings at the right show four of the most famous extinct species of the past 300 years. Moas lived in New Zealand, dodos on the island of Mauritius in the Indian Ocean, and great auks and passenger pigeons in North America.

WORLD BOOK illustrations by Venner Artists, Ltd.



cies died out was relatively slow compared with the rate of extinction during modern times. More than 80 kinds of birds have become extinct in the last 300 years. Some died out as a result of natural causes. However, human beings killed off most of them, chiefly by destroying their habitats but also by overhunting.

The first birds wiped out by people during modern times were the dodos of Mauritius, an island in the southwestern Indian Ocean. Dodos were large, pigeon-like, flightless birds. They were killed off by the late 1600's chiefly by sailors, who hunted them for food. Since the 1800's, large areas of tropical rain forest have been cut down in Asia, Africa, and South America. With the destruction of their natural habitat, a number of tropical birds have become extinct.

At least four species of North American birds have died out since the arrival of the first white settlers. These birds are the Carolina parakeet, great auk, Labrador duck, and passenger pigeon. All of them, except perhaps the Labrador duck, died out as a result of human activities. The loss of the Labrador duck may have been due to overhunting or to a natural disaster. Several other North American species have not been sighted for several years and may be extinct. They include Bachman's warbler and the ivory-billed woodpecker.

Endangered species. About 210 kinds of birds throughout the world have become so rare that they are considered endangered. About 65 of these species are native to the United States, chiefly Hawaii. These birds include nearly all the 16 surviving species of Hawaiian honeycreepers as well as the nene, or Hawaiian goose. Endangered birds of the U.S. mainland include the Eskimo curlew, red-cockaded woodpecker, whooping crane, and Kirtland's warbler.

Loss of habitat caused the decline of such mainland species as Bachman's warbler and the ivory-billed woodpecker. Hunters killed many Eskimo curlews and whooping cranes. Also, the use of pesticides, especially DDT, contaminated the food of the bald eagle, the osprey, and the brown pelican in some areas. One result of this contamination was that the eggs laid by the birds had such thin shells that they cracked under the weight of the incubating parent. Loss of habitat, illegal hunting, and illegal egg collecting all contributed to the decline of the California condor.

Protective laws and programs are helping save some endangered birds. Since 1972, DDT has been prohibited in the United States. Bald eagles, ospreys, brown pelicans, and peregrine falcons are breeding successfully again in once-polluted areas. The number of nenes has been increased by breeding the birds in captivity and releasing the offspring into the wild. Conservationists are breeding California condors in captivity and have released some of these birds into the wild.

One of the most difficult bird conservation efforts has been to increase the number of whooping cranes. In the mid-1970's, eggs of whooping cranes were collected from the birds' nests in Canada and placed in the nests of a flock of sandhill cranes in Idaho. These birds hatched the eggs and raised the whooping cranes along with their own families. Conservationists had hoped the whooping cranes would reproduce and establish their own flock. However, the whooping cranes did not mate, and the project was discontinued in 1989. In 1993, biologists began to release 1-year-old whooping cranes at the Kissimmee Prairie in south-central Florida. The goal of this program is to establish a resident flock of whooping cranes in Florida. Scott M. Lanyon

Protecting species

A California condor chick raised in a captive breeding project takes food from a puppet resembling an adult condor, *left.* Scientists hope to raise many of these endangered birds and release them into the wild. Wildlife refuges preserve the habitats of such birds as the bald eagle, *right.*

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A classification of birds

Birds make up the class Aves, one of the eight classes of vertebrates. Within the class, birds are divided into orders and the orders into families. The classification system given below is a traditional one followed by many ornithologists. It is based largely on internal anatomy, with orders listed in a sequence believed to progress from the most primitive to the most advanced birds.

Class Aves—Birds

Subclass Neornithes—True birds

WORLD BOOK illustrations by Jean Helmer and Paul D. Turnbaugh

Order Struthioniformes—Large, flightless, two-toed birds of Africa, Australia, New Zealand, and South America; cassowary, emu, kiwi, ostrich, rhea families.

Ostrich

Order Tinamiformes—Quaillike birds of Central and South America; tinamou family.

Tinamou

Order Craciformes—Turkeylike birds of Central and South America, Australia, and the Pacific Islands; guan and megapode families.

Crested Guan

Order Galliformes—Fowllike birds; guineafowl, pheasant, quail families.

Pheasant

Order Anseriformes—Water birds with webbed or long, unwebbed toes; duck, magpie goose, screamer, whistling duck families.

Duck

Order Turniciformes—Three-toed quail of Africa, Australia, and the Pacific Islands; buttonquail family.

Little buttonquail

Order Piciformes—Tree-dwelling birds that nest in holes; barbet, honeyguide, toucan, woodpecker families.

Toucan

Order Galbuliformes—Large insect-eating birds of the tropical Americas; jacamar and puffbird families.

Jacamar

Order Bucerotiformes—Large-billed birds of the African and Asian tropics; hornbill and ground-hornbill families.

Great Indian hornbill

Order Upupiformes—Long-billed birds that nest in holes; hoopoe, scimitar-bill, woodhoopoe families.

Common hoopoe

Order Trogoniformes—Long-tailed, brightly colored, fruit-eating tropical birds with weak feet; trogon family.

Trogon

Order Coraciiformes—Varied group of mostly tropical birds with fused toes; bee-eater, cuckoo-roller, kingfisher, motmot, tody families.

Kingfisher

Order Coliiformes—Fruit-eating birds of Africa with a long tail and four toes pointing forward; mousebird family.

Mousebird

Order Cuculiformes—Varied group of tree- and ground-dwelling birds; ani, coucal, cuckoo, hoatzin, roadrunner families.

Cuckoo

Order Psittaciformes—Seed-, nectar-, and fruit-eating birds with hooked bills and mostly bright colors; parrot family.

Parrot

Order Apodiformes—Strong-winged, weak-footed birds that spend much time flying; swift and tree-swift families.

Common swift

Order Trochiliformes—Small, brightly colored, nectar-feeding birds of the Americas; hummingbird family.

Hummingbird

Order Musophagiformes—Tree-dwelling birds of Africa with reversible outer toe; turaco family.

Red-crested turaco

Order Strigiformes—Nighttime birds of prey; includes the barn owl, frogmouth, nighthawk, oilbird, owl, and potoo families.

Owl

Order Columbiformes—Pigeonlike birds; pigeonfamily.

Pigeon

Order Gruiformes—Varied group of land and marsh birds; bustard, crane, kagu, limpkin, mesite, rail, seriema, sunbittern, trumpeter, and other families.

Rail

Order Ciconiiformes—Wading birds, birds of prey, and shorebirds; albatross, eagle, falcon, flamingo, gull, heron, loon, pelican, penguin, plover, sandgrouse, sandpiper, vulture, and other families.

Heron

Order Passeriformes—Perching birds; about 60 families, including broadbill, crow, flycatcher, thrush families.

Thrush

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Dodo
Elephant bird
Hesperornis
Moa
Passenger pigeon

Flightless birds

Cassowary
Emu
Kiwi
Ostrich
Penguin
Rhea
Tinamou

Swimming and diving birds

Albatross
Anhinga
Arctic tern
Auk
Booby
Brant
Canada goose
Canvasback
Coot
Cormorant
Duck
Eider duck
Flamingo
Fulmar
Gadwall
Gallinule
Goose
Grebe
Guillemot
Gull
Kittiwake
Loon
Mallard
Murre
Pelican
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Falcon
Harpy eagle
Harrier
Hawk
Jaeger
Kestrel
Kite
Lammergeier
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Owl
Peregrine falcon
Roadrunner
Secretary-bird
Sparrowhawk
Spotted owl
Vulture

Fowllike birds

Chicken
Curassow
Grouse
Guan
Guineafowl
Hoatzin
Junglefowl
Mound bird
Nene
Partridge
Peacock
Pheasant
Prairie-chicken
Ptarmigan
Quail
Ruffed grouse
Tragopan
Turkey

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Dove
Homing pigeon
Mourning dove
Pigeon
Turtle dove

Parrots

Cockatoo
Kea
Lovebird
Macaw
Parakeet
Parrot

Woodpeckers

Flicker
Sapsucker
Woodpecker
Wryneck
Yellowhammer

Songbirds

Babbler
Baltimore oriole
Bird-of-paradise
Blackbird
Blue jay
Bluebird
Bobolink
Bowerbird
Brown thrasher
Bulbul
Bullfinch
Bunting
Canary
Cardinal
Catbird
Chat
Chickadee
Cowbird
Crossbill
Crow
Cuckoo-shrike
Dickcissel
Dipper
Finch
Flowerpecker
Gnatcatcher
Goldfinch
Grackle
Grosbeak
Hawaiian honeycreeper
Honeyeater
House sparrow
Indigo bunting
Jackdaw
Jay
Junco
Kinglet
Lark
Linnet
Magpie
Martin
Meadowlark
Mockingbird
Myna
Nightingale
Nutcracker
Nuthatch
Oriole
Pewee
Pine siskin
Pipit
Pitohui
Raven
Redpoll
Redstart
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Shrike
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Starling
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White-eye
Wren
Yellowthroat

Other birds

Ani
Apostlebird
Bee-eater
Bellbird
Bustard
Cock-of-the-rock
Crane
Creeper
Cuckoo
Flycatcher
Frigatebird
Goatsucker
Hoopoe
Hornbill
Hummingbird
Kingbird
Kingfisher
Kookaburra
Lyrebird
Manakin
Motmot
Nighthawk
Oilbird
Ovenbird
Phoebe
Quetzal
Roller
Skimmer
Swift
Toucan
Touraco
Trogon
Umbrellabird
Upland sandpiper
Whippoorwill

Other related articles

Audubon, John James
Audubon Society, National
Bird's-nest soup
Conservation
Egg
Falconry
Feather
Fish and Wildlife Service
Guano
Miner, Jack
Molting
Ornithology
Oviraptor
Peterson, Roger T.
Poultry
Protective coloration
Psittacosis
Redbird

Outline

I. **The importance of birds**
   A. In nature
   B. As a source of food and raw materials
   C. As pets
II. **The distribution of birds**
III. **Birds of North America**
   A. Birds of urban areas
   B. Birds of forests and woodlands
   C. Birds of grasslands
   D. Birds of brushy areas
   E. Birds of the desert
   F. Birds of inland waters and marshes
   G. Birds of the seacoasts
   H. Birds of the Arctic
IV. **Birds of other regions**
   A. Birds of the ocean and the Antarctic
   B. Birds of Central and South America
   C. Birds of Europe and Asia
   D. Birds of Africa
   E. Birds of Australia and the Pacific Islands
V. **How birds live**
   A. How birds get food
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   D. Laying and hatching eggs
   E. Caring for the young
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VII. **Bird migration**
   A. Why birds migrate
   B. Where birds migrate
   C. How birds migrate
VIII. **The bodies of birds**
   A. External features
   B. Skeleton and muscles
   C. Senses
   D. Systems of the body
IX. **Bird study and protection**
   A. Bird watching
   B. Birdbanding
   C. Bird refuges
   D. Protective laws and treaties
X. **The development of birds**
   A. The first known birds
   B. The first modern birds
   C. Extinct birds
   D. Endangered species

Questions

Why do birds migrate?
Why do small birds eat relatively more than large ones?
How do birds help farmers?
What are some ways in which endangered species of birds are being protected and saved?
Which are the only birds that can fly backward?
Why do Europe and North America have different species of birds?
Why do Europe and Asia have many of the same species?
How do birds care for their feathers?
What is a *territory?* An *advertising song?* A *pair bond?*
At what age are most birds ready to mate?
How does birdbanding enable scientists to learn about the life history of individual birds?

Additional resources

All states in the United States and provinces in Canada have collections of books or pamphlets about birds that inhabit their areas. These materials are available at local libraries.

Level I

Lerner, Carol. *Backyard Birds of Summer.* Morrow, 1996. *Backyard Birds of Winter.* 1994.
Sayre, April P. *Endangered Birds of North America.* 21st Century Bks., 1997.
Weidensaul, Scott. *National Audubon Society First Field Guide: Birds.* Scholastic, 1998.
Williams, Nick. *How Birds Fly.* Benchmark Bks., 1997.

Level II

Attenborough, David. *The Life of Birds.* Princeton, 1998.
Bird, David M. *The Bird Almanac: The Ultimate Guide to Essential Facts and Figures of the World's Birds.* Firefly Bks., 1999.
Forshaw, Joseph, ed. *Encyclopedia of Birds.* 2nd ed. Academic Pr., 1998.
Gingras, Pierre. *The Secret Lives of Birds.* Firefly Bks., 1997.
Sibley, David A. *The Sibley Guide to Birds.* Knopf, 2000.
Wade, Nicholas, ed. *The Science Times Book of Birds.* Lyons Pr., 1997.

Bird, Larry (1956-), ranks among the best all-around basketball players in the history of the game. A 6-foot 9-inch (206-centimeter) forward, Bird played 13 seasons for the Boston Celtics of the National Basketball Association (NBA). Bird excelled in all the major phases of basketball—shooting, passing, rebounding, and defense.

Larry Joe Bird was born in French Lick, Indiana. He attended Indiana State University from 1975 to 1979. Bird was named College Player of the Year in 1979. He joined the Celtics following his graduation and was named NBA Rookie of the Year for the 1979-1980 season. Bird helped lead the Celtics to NBA titles in the 1980-1981, 1983-1984, and 1985-1986 seasons. He was also named the league's Most Valuable Player for the 1983-1984, 1984-1985, and 1985-1986 seasons. Bird announced his retirement in 1992 after playing on the United States team that won the championship in the 1992 Olympic Games.

In 1997, Bird became coach of the Indiana Pacers of the NBA. He was named the league's Coach of the Year for the 1997-1998 season. Bird retired as coach of the Pacers after the 1999-2000 season. *Drive* (1989) is Bird's autobiography. Bird discussed playing and coaching basketball in *Bird Watching* (1999). William F. Reed

See also **Basketball** (picture).

Bird-of-paradise is the name given to certain kinds of birds with plumage of many dazzling colors. The plumage grows in many unusual forms. The closest relatives of the birds-of-paradise are the crows.

There are 43 known kinds of birds-of-paradise. Most of them live on the tropical island of New Guinea and on smaller neighboring islands. A few kinds live in northern Australia. The bird-of-paradise also was introduced to Little Tobago, an island in the West Indies. This island is the only place in the Western Hemisphere where the bird lives in its wild state. Birds-of-paradise live in forests. They feed on fruits and insects.

Europeans learned of these beautiful birds early in the 1400's. Bird-of-paradise skins with the legs removed were used as articles of trade in Java at that time. In this way began the mistaken idea that birds-of-paradise flew continually around the sun and dropped to earth only when they died. The Swedish naturalist Linnaeus believed this story. In 1753 he named the greater bird-of-paradise *Paradisaea apoda,* which means *footless paradise bird.* Before the mating season, the male birds-of-paradise gather in a tree to display themselves to the

WORLD BOOK illustrations by Walter Linsenmaier

dull-colored females by strutting, dancing, and spreading their plumes. After mating, the birds build nests. The female lays from one to three spotted white eggs.

The *greater bird-of-paradise* is one of the largest kinds. It is about the size of a crow. Its forehead and throat are a glittering emerald green. The head is golden yellow, and the wings and tail are maroon. A dense mass of plumes about 2 feet (61 centimeters) long springs from under the wings. The *lesser bird-of-paradise* looks much like the greater bird-of-paradise.

The *King of Saxony bird-of-paradise* is about as large as a robin. It is black, with a yellow belly and wings edged with yellow. Two long shafts grow from the sides of its head. Attached to each shaft is a series of small parts of feathers. They make the shaft look like a wire hung with many little bright-blue flags.

The little *king bird-of-paradise* has shining scarlet feathers, a white belly, and a band of brilliant emerald green across its breast. On each side of the breast grow tufts of feathers tipped with a green hue which gleams like metal. These tufts can be spread out like fans. The two middle feathers of the tail are like long bare wires which end in spiral emerald-colored disks.

Wilson's bird-of-paradise has bare patches of cobalt-blue skin on its head. On the back of its neck is a tuft of yellow feathers which can be raised to form a halo. The back of the bird is scarlet, and the breast is a dazzling moss-green. The narrow central feathers of the tail are blue. They curve across each other and then curl spirally into a circle.

Many birds-of-paradise have been killed by plume-hunters, who sold their beautiful feathers for decorations on hats. It is now forbidden to kill these birds. Laws forbid the importation of the plumage of birds-of-paradise into the United States. Fred J. Alsop, III

Scientific classification. The bird-of-paradise belongs to the family Paradisaeidae. The scientific name for the greater bird-of-paradise is *Paradisaea apoda;* the King of Saxony bird-of-paradise is *Pteridophora alberti;* the king bird-of-paradise is *Cicinnurus regius;* and Wilson's bird-of-paradise is *C. respublica.*

See also Bird (picture: A male Count Raggi's bird-of-paradise).

Bird-of-paradise flower is a small plant of South Africa with orange-and-blue flowers and banana-shaped leaves. The blue-green leaf which carries the flower looks somewhat like a boat. The flowers have three sepals and three petals, and resemble flying birds of paradise. The flowers are grown in California, Florida, and Hawaii. They last up to two weeks when cut. See also Flower (picture: Flowers of the tropics and subtropics). Michael J. Tanabe

Scientific classification. The bird-of-paradise flower belongs to the family Strelitziaceae. Its scientific name is *Strelitzia reginae.*

Bird refuge. See Bird (Bird refuges).

Birdbanding. See Bird (Birdbanding).

Birdhouse. See Bird (Bird watching; picture).

Birdlime. See Banyan tree.

Bird's-foot trefoil, *TREE foyl,* is a perennial plant native to temperate regions in Europe and Asia. It also

grows in the United States and Canada. It is sometimes called *babies'-slippers.* The plant is grown for forage, but it releases cyanide compounds when it wilts and then can be poisonous to livestock. It is often used in rock gardens as a trailing vine. It blooms all summer and autumn with clusters of yellow flowers tinged with bright red. Daniel F. Austin

Scientific classification. The bird's-foot trefoil belongs to the pea family, Fabaceae or Leguminosae. Its scientific name is *Lotus corniculatus.*

Bird's-nest soup is a famous Chinese dish. This unusual soup is made from the nests of swiftlets, certain southeastern Asian birds belonging to the swift family. The nests are held together by the hardened saliva of male swiftlets. When cooked, the nests take on a chewy consistency that adds a pleasing texture to the soup. The soup's taste comes mainly from the type of broth in which the nests are cooked. In the best-known type of bird's-nest soup, the nests are cooked in a thickened chicken broth mixed with *velvet chicken* (fluffy egg white and finely chopped chicken). Other kinds of bird's-nest soups include a salty soup that is usually served as an appetizer and a sweet, dessert soup made with watermelon. Margaret McWilliams

Birds of prey. See **Bird** (Kinds of food). For a list of separate articles on birds of prey, see the *Related articles* at the end of the **Bird** article.

Birdseye, Clarence (1886-1956), pioneered the development of packaged frozen foods. While on a fur-trading trip to Labrador about 1915, Birdseye noted that quickly frozen fish were flavorful and fresh when thawed. He first marketed quick-frozen fish in 1925. General Foods Corporation later acquired the process. Birdseye invented a food-dehydrating process in 1949. He acquired about 300 patents during his life. He was born in Brooklyn, New York, and graduated from Amherst College. See also **Food, Frozen.** William R. Childs

Bireme. See **Galley.**

Birgitta, Saint. See **Bridget, Saint.**

Birling, or logrolling, is a sport in which two contestants spin a floating log rapidly with their feet. They stop it suddenly and reverse motion, trying to throw their opponent off balance and into the water. Falling off a log into the water counts as a *fall.* The first contestant to cause two out of three falls wins. Contestants begin on logs 15 inches (38 centimeters) in diameter. As the competition continues, progressively smaller logs are used. Competitors wear special *calked* (spiked) birling shoes.

Birling originated in the 1800's in lumberjack camps in New England. The sport followed the westward development of the United States, becoming popular in forests around the Great Lakes and in the Pacific Northwest. Birling competitions still flourish in lumberjack shows in the United States and Canada. Julie Janke

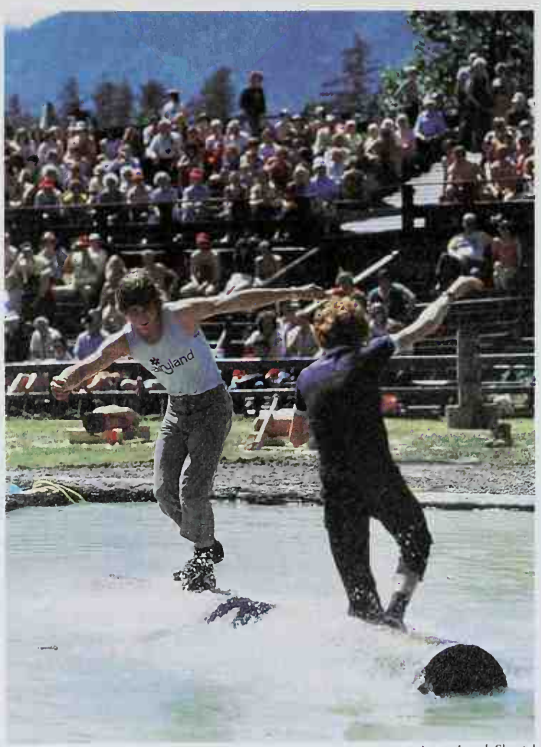
Birmingham, *BUR mihng HAM* (pop. 242,820; met. area pop. 921,106), is the largest city in Alabama and a leading steel-making, educational, and medical center. Birmingham lies in Jones Valley at the foot of Red Mountain in north-central Alabama. For location, see **Alabama** (political map).

The rich land of Jones Valley contains all three major ingredients of steel—coal, iron ore, and limestone. In 1870, two railroads completed tracks leading into the valley. The Elyton Land Company, a group of bankers and investors, helped found Birmingham in 1871 at the place where the railroads met. The group named the community for the large English steel-producing city of Birmingham.

The city. Birmingham, the county seat of Jefferson County, covers about 152 square miles (394 square kilometers). The metropolitan area consists of Jefferson, Shelby, St. Clair, and Blount counties—an area of 3,238 square miles (8,386 square kilometers). The city's central business district occupies the area around First Avenue and 20th Street North. The University of Alabama at Birmingham (UAB), including the UAB Medical Center, occupies 64 blocks south of the financial district. Most of the city's industries are located in the western and northern sections. Residential neighborhoods lie chiefly in the eastern and southern parts. For the monthly weather in Birmingham, see **Alabama** (Climate).

About 99 percent of the city's people were born in the United States. Blacks make up about 73 percent of the city's population and 30 percent of the metropolitan area's population.

Economy. The steel industry plays a major role in the economy of the Birmingham area. But since the mid-1940's, the area's economy has depended less on steel production. Employment in the medical and health fields has grown greatly since the UAB Medical Center opened in 1945. UAB is Birmingham's largest employer. The telecommunications industry also has much importance in the economy. The BellSouth telephone company maintains a large operation in the city.



James Israel, Shostal

In a birling contest, the contestants spin a log rapidly with their feet to try to make their opponent fall into the water.

©Don Newton, Jr., Birmingham Area Chamber of Commerce

Birmingham is the largest city in Alabama and a steel-making center. The downtown area has many tall office buildings.

The more than 850 manufacturing firms in metropolitan Birmingham employ about 15 percent of the area's workers. They produce chemicals, cast-iron pipe, and transportation equipment, as well as iron and steel. Other industries include banking, publishing, and food processing.

Airlines, passenger railroad trains, and interstate highways connect Birmingham to other cities. Fourteen railroad freight lines and about 100 truck lines serve the city. Docks on the Warrior River, 20 miles (32 kilometers) west of Birmingham, provide a water link with the Tennessee-Tombigbee Waterway system and the port of Mobile, Alabama.

The city has two daily newspapers, *The Birmingham News* and the *Birmingham Post-Herald.* Seven television stations and about 30 radio stations broadcast to the metropolitan area.

Education and cultural life. Birmingham's public school system includes 52 elementary schools, 16 middle schools, and 10 high schools. The city also has more than 50 private and parochial schools. In addition to UAB, colleges and universities in the area include Birmingham-Southern College, Miles College, and Samford University. Birmingham's public library system consists of a central library and 19 branches.

The Birmingham Museum of Art owns part of the Kress collection of Italian paintings. The city has a symphony orchestra, a civic opera, a ballet company, and a number of theater groups.

Birmingham's 65 public parks cover about 1,550 acres (627 hectares). The largest cast-iron statue in the world, *Vulcan,* stands 55 feet (17 meters) high in Vulcan Park on Red Mountain. This statue represents the Roman god of fire and metalworking. The Birmingham Zoo ranks as one of the largest zoos in the Southeast. A Birmingham mansion called Arlington, built before the American Civil War, is open to the public.

Government. Birmingham has a mayor-council form of government. The mayor serves as the administrative head of the government. The voters elect the mayor to a four-year term. Birmingham has nine city council members, also elected to four-year terms. The elections for mayor are spaced two years apart from elections for city council members. Birmingham gets most of its revenue from business license fees, sales tax, and other taxes.

History. Cherokee, Choctaw, and Creek Indians hunted in Jones Valley before whites came to the area. The first white settlement there occurred in 1813. During the American Civil War (1861-1865), small ironworks were built in Jones Valley. By 1870, the area's mineral riches had attracted two railroads. Birmingham was founded in 1871 at the junction of the railroads and was incorporated as a city later that same year.

Birmingham grew rapidly, but in 1873, a cholera epidemic and a national business panic almost destroyed the new community. Then, in 1880, Alabama's first blast furnace began operating in Birmingham. The city's industries expanded as the 1880's brought increased demands for iron. The population grew so quickly—from 3,086 in 1880 to 132,685 in 1910—that Birmingham got the nickname of the *Magic City.*

The nation's demand for iron and steel declined after the Great Depression began in 1929. Birmingham became one of the hardest-hit areas in the country during the Depression. Prosperity finally returned to Birmingham when World War II (1939-1945) brought new demands for steel. During the late 1940's and the 1950's, Birmingham became one of the South's leading industrial centers.

In 1963, blacks and whites clashed in Birmingham over the issue of racial integration. The tension increased, and President John F. Kennedy sent federal officials into the area to help settle differences. Later that year, a bomb exploded in a black church, killing four black girls. Interracial groups then organized and began working to prevent further trouble.

A period of new construction began in Birmingham during the late 1960's. The Birmingham-Jefferson Civic Center opened in 1976. It includes a coliseum, concert and exhibition halls, and a theater. It was expanded in 1992 to include a medical forum and a 770-room hotel. The UAB Medical Center opened several research and treatment facilities in the late 1970's, the 1980's, and the 1990's.

The 34-story SouthTrust Building, Alabama's tallest office building, was completed in downtown Birmingham in 1986. The state's largest office building, headquarters of the Alabama Power Company, was also completed in 1986.

Birmingham's population, like that of many other cities, declined during the 1970's, 1980's, and 1990's. But the metropolitan area population increased, as many white residents moved from the city to the suburbs.

In 1979, the voters elected Richard Arrington, Jr., as Birmingham's first black mayor. In 1985, blacks gained a majority on the city council for the first time. Arrington was reelected four times. He retired in 1999.

James E. Jacobson

Birmingham (pop. 934,900; met. area pop. 2,500,400), ranks as the second largest city in the United Kingdom. Only London has more people. Birmingham and the surrounding communities form the United Kingdom's chief manufacturing area. The city lies in west-central England

on a plateau bounded by the rivers Trent, Avon, and Severn. For location, see **England** (political map).

Birmingham's main business area has many high-rise buildings. The nearby Centenary Square is the city's main cultural center. It includes a concert hall, a theater, and one of Europe's largest city libraries. The city has a symphony orchestra, and it is the home of the Birmingham Royal Ballet. Its historic buildings include Aston Hall, completed in 1635, St. Philip's Cathedral, which was built in 1715, and the Town Hall, which opened for public meetings and concerts in 1834. The area has three universities: the University of Aston, the University of Birmingham, and the University of Central England.

Birmingham has many high-rise residential buildings, but most people live in single-family houses. The older areas of the city have many *row houses*, lines of houses that are attached to one another and look alike.

Birmingham's factories manufacture a wide variety of products. The chief items include automobiles, beer, chocolate, fabricated metal products, jewelry, machine tools, and transportation equipment.

Anglian settlers founded Birmingham, probably in the A.D. 600's. The city became a trading center during the 1100's, and industries began to develop there in the 1500's. Birmingham was able to grow into an industrial city because of its nearby coal and iron ore deposits and other important natural resources. During the Industrial Revolution of the 1700's and early 1800's, Birmingham became a major industrial center of Britain (see **Industrial Revolution**). Job opportunities attracted many people to Birmingham, and its population increased from about 70,000 in 1801 to over 800,000 by the early 1900's.

Many sections of Birmingham, including the central business district, were heavily damaged by German bombs during World War II (1939-1945). The city did much rebuilding during the 1950's and 1960's. Workers constructed residential and commercial buildings and many new roads. In the late 1900's, Birmingham greatly expanded its cultural facilities. Symphony Hall opened in 1991. Anthony Sutcliffe

Birney, Alice Josephine McLellan (1858-1907), was a cofounder of the National Congress of Mothers (NCM). She and Phoebe A. Hearst started the NCM in 1897, and Birney served as its first president. In 1925, the NCM became the National Congress of Parents and Teachers, the national organization of local parent-teacher associations (PTA's).

Alice McLellan was born in Marietta, Georgia. She married Theodore W. Birney in 1892, and they had two daughters. As a mother, she felt that parents should participate more in their children's development. Under her leadership, the NCM encouraged child study and supported local child welfare groups. It also organized state branches to promote cooperation between parents and teachers. Birney resigned as president in 1902.

Birney wrote several articles on child-raising for the *Delineator*, a women's magazine. They were published in a book, *Childhood* (1905). Kim O'Connor Kellogg

See also **Hearst, Phoebe A.**

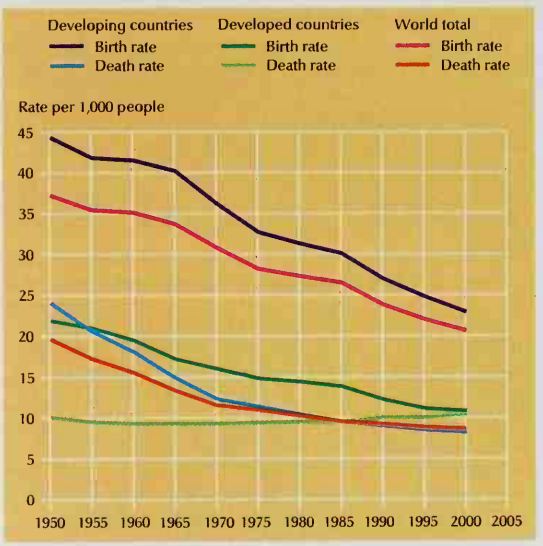
Birth. See **Childbirth; Multiple birth; Reproduction, Human.**

Birth and death rates are important measurements of population changes. They provide a way to compare health trends and other population information from one year to another or from one community to another. The simplest kind of birth or death rate measures the number of births or deaths in a given year for every 1,000 people. For example, the *crude birth rate* for the United States is about 14 births for every 1,000 people. The *crude death rate* is about 9 deaths for every 1,000 people. The death rate is also called the *mortality rate*. A condition in which the birth rate is equal to the death rate is called *zero population growth*.

Births and deaths can also be compared in other ways. For example, the *fertility rate* relates the number of births to the number of women of child-bearing age. The *age-specific birth rate* compares the number of births by women of a certain age to the total number of women in that age group. The *infant mortality rate* compares the total number of infants who die during the first year of life to 1,000 live births. Karl Taeuber

World birth and death rates

This graph shows the differences in birth and death rates for developing and developed countries. The gap between developing and developed countries has narrowed since the 1950's.



Source: United Nations.

Related articles in *World Book* include:

Baby boom generation
Birth control (The birth control movement)
Census
Infant mortality
Population
Sex ratio
Vital statistics

Birth certificate is a legal record of a person's birth. It gives essential facts, such as birthday, birthplace, sex, race, and parents' names. An official copy of a birth certificate may be needed to prove a person's citizenship or to obtain a driver's license, a job, schooling, or a passport. Registration of all births is required by law. Ordinarily, the hospital or attending physician files the certificate with county, state, or provincial government registrars. Copies of birth certificates may be obtained from these officials. People who lack official birth certificates may be able to draw evidence of age or birthplace from old censuses. For information, people may write to their national census agency. Karl Taeuber

See also **Vital statistics.**

Birth control is a term that includes all methods used to regulate or prevent the birth of children. Other terms with a similar meaning are *birth planning, family planning, fertility control,* and *planned parenthood.*

When people talk about birth control, they are usually referring to artificial methods. But nature itself has built-in controls for limiting and spacing births. A woman can become pregnant only during a small fraction of her monthly menstrual cycle. In addition, women are able to conceive only during a certain time in their lives—usually between the ages of 13 and 45. Also, some couples, for various reasons, are temporarily or permanently *infertile* (unable to have children). See **Infertility.**

Couples practice birth control for various reasons. They may want to limit or space their children, or to have no children at all. Young couples often postpone having children so that both the husband and wife can work full-time. Other couples space their children so they can give each child as much attention as possible. Doctors advise some women to prevent pregnancy for health reasons. In many countries with rapidly growing populations, the government encourages couples to limit the size of their families.

Most people in industrialized nations agree that some form of family limitation or spacing is desirable for the good of the family and society. But individuals and groups—especially religious groups—differ sharply on the methods of birth control that they consider moral and acceptable. This article discusses the main arguments for and against birth control, the principal methods of birth control, and the status of birth control programs.

The birth control movement

For thousands of years, birth control received little public attention. Death rates were extremely high, particularly in infancy and childhood. Large numbers of children were necessary to ensure that enough would survive to adulthood and have children of their own. Then, during the 1700's and 1800's, scientific and technological advances in industrialized countries increased food supplies, controlled diseases, and made work easier. The death rate then dropped in these countries. More children survived and had children themselves.

In 1798, the British economist Thomas Robert Malthus published his famous *Essay on the Principle of Population.* Malthus argued that populations tend to increase faster than food supplies. To reduce births, he recommended that young men and women postpone marriage. During the 1800's, a number of people in Europe and the United States worked to promote birth control. Partly through their efforts, birth rates in industrialized countries began to drop to the present low levels. See **Malthus, Thomas Robert.**

Most developing countries continue to have high birth rates. For example, Bangladesh and Pakistan have about 40 live births a year for every 1,000 people. Industrialized nations have much lower birth rates. For example, the United States has about 16 births a year per 1,000 population. Japan has about 10.

Death rates in developing countries have dropped since the mid-1940's, partly because of improved public health. The result of continuing high birth rates and low death rates has been rapid population growth in Asia, Africa, and Latin America. In many countries, far more children are born than can be adequately fed, housed, educated, or employed under present conditions.

The fear of overpopulation has spurred interest in birth control. The population of the world passed 5 billion in 1987 and reached about 6 billion in the late 1990's. At the present rate of increase, the world population will have reached about 10 billion by the year 2030.

During the first half of the 1900's, Margaret Sanger led the birth control movement in the United States. Sanger, a trained nurse, worked among the poor and saw the unhappiness caused in many families by the burden of too many children. She believed that unwanted pregnancy should be avoided by birth control methods. The distribution of birth control information was illegal, but Sanger opened clinics and advised people on the subject. She was arrested several times, but she helped get laws passed permitting doctors to give birth control information. See **Sanger, Margaret.**

Sanger helped found the American Birth Control League, which later became the Planned Parenthood Federation of America. Similar private family planning groups in other countries started many of the birth control programs that are now carried on both privately and by governments throughout the world.

Methods of birth control

An understanding of birth control requires some knowledge of human reproduction. About every four weeks, an egg is released by one of the two ovaries in a woman's body. The egg then passes through a fallopian tube. If it is not fertilized while in the fallopian tube, it dies there and eventually disintegrates in the uterus. The egg then passes out of the woman's body as part of the normal monthly bleeding called menstruation (see **Menstruation**).

During sexual intercourse, millions of sperm are released by the man into the woman's vagina. Some sperm travel through the uterus into the fallopian tubes. If an egg and sperm unite in one of the tubes, *conception* (fertilization of the egg) occurs. If the fertilized egg becomes attached to the wall of the uterus, a new human being begins to develop. About nine months later, a baby is born. See **Reproduction, Human.**

Most birth control methods are designed to prevent conception and are called *contraceptives.* The most effective contraceptive method is *surgical sterilization.* The operation can be performed on both men and women. It makes conception impossible by blocking the sperm ducts in men or the fallopian tubes in women. Such an operation is called a *vasectomy* on a male. On a female, it is called a *laparoscopic sterilization,* a *tubal ligation,* or a *tubectomy,* depending on the procedure used. These operations can seldom be reversed if a couple later desires to have children.

Other highly effective contraceptive methods involve the use of hormone drugs in order to prevent pregnancy. *Oral birth control pills* contain the sex hormones *estrogen* and *progesterone.* These drugs, also called *oral contraceptives,* hinder both the normal release of an egg once a month and the attachment of an egg to the uterus. Birth control pills are relatively expensive, require regular use to prevent pregnancy, and may produce harmful side effects in some women. In many de-

veloping nations, hormone drugs may be injected into the body. The injections must be given every 90 days and are as effective as birth control pills. In addition, *contraceptive implants* that contain hormone drugs are available in some countries, including the United States and Canada. The implants consist of tiny capsules that are surgically placed under the skin. The capsules slowly release hormone drugs into the body. The implants must be replaced periodically by a doctor and may be removed if pregnancy is desired.

Intrauterine devices, also called *IUD's,* are another highly effective method of contraception. An IUD is a tiny device made of plastic and metal. It is inserted into the uterus. Doctors are not yet sure how IUD's prevent pregnancy. When a woman wishes to become pregnant, she has the device removed. IUD's are relatively inexpensive and they require little attention for most women. But some users experience undesirable side effects. Such effects cease when the IUD is removed.

There are also several other methods of contraception. The *condom* is a thin sheath worn over the penis during sexual intercourse. Sperm are trapped inside the condom. The *diaphragm* and the *cervical cap* are devices that are inserted into the vagina so that they cover the opening of the uterus. A *spermicide*—a drug that kills sperm—must be applied to the diaphragm or cervical cap. These devices then hold the spermicide near the opening of the uterus. A spermicide-treated device called the *vaginal sponge* works on similar principles as the diaphragm and the cervical cap. *Vaginal spermicides,* in the form of creams, gels, and suppositories, can be used by themselves, but they are less effective in preventing conception. An even less effective method is *withdrawal,* in which the male attempts to withdraw the penis from the vagina before the sperm are released.

Natural family planning consists of several methods that can be used either to prevent or to encourage conception. The *rhythm method* of birth control calls for avoidance of intercourse during the estimated period each month when an egg can be fertilized. The rhythm method works for some couples, but it is generally less effective than many other methods. The chief problem of the rhythm method is determining a woman's fertile period. The method is most unreliable for women with irregular menstrual cycles. Another method of natural family planning tests mucus from the woman's *cervix* (neck of the uterus). By observing periodic changes in the mucus, a woman can predict her fertile period. Another method uses body temperature measurements to indicate the fertile period. The *sympto-thermal method* combines the taking of temperature with the testing of mucus and other observations of changes in the cervix.

An *induced abortion* ends a pregnancy by removing the unborn fetus. Physicians can perform abortions through several different procedures. In the early stages of pregnancy, abortions can also be caused by a drug called *mifepristone* or *RU-486.* Traditionally, many countries have outlawed abortion except when necessary to save a woman's life. But in the 1970's, many countries—including the United States—changed their laws, making it easier for abortions to be obtained. See **Abortion**.

Opposition to birth control

Opposition to birth control continues, even though the practice has gained in acceptance. Some people fear that birth control encourages sexual relations outside of marriage. Some fear that governments might impose birth control as a means of political control. Some religions oppose birth control on moral grounds.

The Roman Catholic Church teaches that artificial methods of birth control are immoral because they separate the two purposes of intercourse in marriage—conjugal love and the procreation of children. In 1968, Pope Paul VI repeated the traditional Roman Catholic viewpoint in a papal encyclical. He wrote that "...each and every marriage act must remain open to the transmission of life." Although the Roman Catholic Church opposes all artificial birth control, it considers natural family planning acceptable.

In the past, most other major religions also opposed birth control or kept silent on the subject. Today, most Protestant faiths and Judaism accept contraception, and many Protestants and Jews support legalized abortion. Hindu and Buddhist religious leaders have seen no religious conflict in the development of government birth control programs in Asian nations.

Birth control today

During the 1960's, many countries—and most states in the United States—adopted government programs of family planning. Where necessary, they repealed laws restricting distribution of birth control information and devices. Today, about 80 countries have national birth control programs. Sweden, the United States, and other developed countries have given funds and technical assistance to less developed countries. Private organizations and such international organizations as the United Nations and the World Health Organization also have helped countries set up birth control programs.

In the United States, according to national surveys, most married couples use some form of birth control. Most Americans obtain birth control information and supplies from their family physician or a pharmacist. The federal government and the states provide family planning as part of their health and welfare programs.

In other countries. In 1948, Japan became the first country to take national action on family planning. That year, the Japanese government legalized abortion and contraception, and began to make both readily available. During the next 10 years, the Japanese birth rate fell from 33 to 17 births per 1,000 population, largely as a result of increased abortion. Legal abortion has also become a major birth control method in Eastern Europe.

China, the world's most populous country, established a government agency to promote birth control in 1964. The country's birth rate dropped from about 40 births per 1,000 in 1964 to 20 births per 1,000 in 1979. It remained at that level through the late 1990's. The agency encouraged later marriages and the use of contraceptives, chiefly sterilization and IUD's.

India began a national birth control program in the early 1950's. Many states in India have developed programs calling for voluntary sterilization of males. Pakistan began a birth control program in 1959. In the early 1960's, South Korea and Taiwan began birth control programs. Many developing countries have started similar programs, most of which rely on oral birth control pills.

In Canada, many provincial and city governments

support family planning with assistance by the national government. In the United Kingdom, family planning services are part of the National Health Service. Most other countries in Europe also have government-supported programs of family planning. James Trussell

See also **Abortion; Planned Parenthood Federation of America; Population; Ehrlich, Paul R.; Laparoscopy; Vasectomy.**

Birth defect is an abnormality in the structure or function of the body that is present at birth. The term *birth defect* often refers to a body part with a structural abnormality, such as a clubfoot or cleft lip. However, some authorities also consider inherited diseases that don't produce a visible abnormality, such as phenylketonuria and sickle cell anemia, to be birth defects. Birth defects are also called *congenital defects.*

There are thousands of known birth defects. Some can be detected immediately at birth. Others become apparent only in later years. Sometimes infants have abnormalities resulting from injury during delivery or from an infection acquired at birth, but most doctors do not consider these abnormalities birth defects.

Birth defects may be major or minor. Major defects are those that usually require medical treatment, often including surgery. Some major birth defects, such as abnormalities of the heart or the respiratory system, can be life threatening. In the United States, approximately 3 percent of all newborn babies have at least one major birth defect. Minor birth defects, such as small birthmarks, often do not require treatment.

Causes. Physicians do not know what causes most birth defects. However, a specific environmental or inherited cause has been identified for some of them. In many cases, factors relating to the baby's environment and heredity may work together to produce them.

Environmental causes are factors outside the fetus that affect its development during pregnancy. For example, some medications can produce birth defects if the mother takes them while pregnant. Certain medical conditions in the mother may also increase the risk of birth defects. For example, if the mother develops rubella early in pregnancy, her baby may have several defects known together as *congenital rubella syndrome.* Environmental factors appear to have their greatest effect on the fetus during the first three months of pregnancy.

Inherited causes. Infants may inherit, from one or both parents, certain conditions that result in birth defects. One such condition is Down syndrome, which occurs when the infant inherits an extra chromosome. Some families appear to be at increased risk for having children with certain birth defects, including cleft lip, cleft palate, and spina bifida (a spine defect).

Prevention and treatment. Because the cause of most birth defects is unknown, doctors often do not know how to prevent them. Avoiding medications that are known to be harmful during pregnancy can prevent some defects. A woman may also prevent certain defects if she follows a proper diet during pregnancy. For example, a woman who takes appropriate amounts of folic acid (a B vitamin) during pregnancy may lessen the chance that her baby will be born with spina bifida.

Genetic counselors can advise couples about their risk of passing a genetic abnormality on to their children. These specialists use medical tests and statistical studies to predict the odds of having a child with a birth defect. For example, Down syndrome occurs more often among infants born to women over age 34, so doctors and genetic counselors commonly advise these mothers about this risk. Some mothers may decide to have an abortion if tests show their baby has a major defect.

Many birth defects can be treated with medications or with surgery. Some defects involving metabolism, such as phenylketonuria, can be treated with a special diet. Some infants with birth defects require other help, including physical therapy and special schooling.

Janet D. Cragan

Related articles in *World Book* include:

Birthmark	Ear (Birth defects)	Phenylketonuria
Cell (Metabolic diseases)	Genetic counseling	Rubella
Cerebral palsy	Heart (Birth defects)	Sickle cell anemia
Cleft palate	Hemophilia	Spina bifida
Clubfoot	Heredity	Tay-Sachs disease
Cretinism	Hyaline membrane disease	Thalidomide
Deafness (Birth defects)		Toxoplasmosis

Additional resources

Edelson, Edward. *Birth Defects.* Chelsea Hse., 1992.
Wynbrandt, James, and Ludman, M. D. *The Encyclopedia of Genetic Disorders and Birth Defects.* 2nd ed. Facts on File, 1999.

Birth rate. See Birth and death rates.

Birthmark is a skin blemish that is present at birth or develops shortly thereafter. There are two main types: *moles* and *hemangiomas* (pronounced *hih MAN jee OH mahz*). This article discusses hemangiomas. For information about moles, see Mole [dermatology].

A hemangioma is a *benign* (harmless) tumor that consists of blood vessels beneath the skin. Physicians are not sure what causes hemangiomas. However, most doctors agree that they are neither hereditary nor caused by an accident during pregnancy. The most common kinds of hemangiomas are *cavernous hemangiomas, port-wine stains,* and *strawberry marks.*

A cavernous hemangioma is a soft, bluish lump composed of large blood vessels. It may grow or shrink, but most cavernous hemangiomas are permanent. Surgery is the only method of removing such birthmarks.

Port-wine stains are flat, permanent hemangiomas that occur most frequently on the face. They may be pink, red, or purple. These blemishes can usually be covered with cosmetics. In certain cases, doctors use the concentrated, high-energy light beams from a laser to fade port-wine stains. Such treatment is effective, but it may take many repetitions to complete.

Strawberry marks are bright red, soft, and raised. Treatment is rarely necessary because almost all of them disappear eventually. Yelva Liptzin Lynfield

Birthstone is a gem associated with a month of the year. Traditionally, a birthstone brings good luck to a person born in its month. Each birthstone also corresponds to a zodiac sign. But the birth dates for each sign do not match the beginning and end of each month.

The belief in birthstones may have come from a Bible story about Aaron, the first high priest of the Israelites. The story describes Aaron's breastplate, which was decorated with 12 precious stones. Early writers linked these stones with the 12 months of the year and the 12 signs of the zodiac.

The custom of wearing the stone that represented a

Birthstones

This table shows the gem or gems accepted by most jewelers as the birthstone for each month, and the characteristic and sign of the zodiac associated with each stone. The birth dates for the signs do not match the beginning and end of the months.

Month	Gem or gems	Characteristic	Sign of the zodiac
January	Garnet	Constancy	Aquarius (Jan. 20-Feb. 18)
February	Amethyst	Sincerity	Pisces (Feb. 19-Mar. 20)
March	Aquamarine Bloodstone	Courage	Aries (Mar. 21-Apr. 19)
April	Diamond	Innocence	Taurus (Apr. 20-May 20)
May	Emerald	Love	Gemini (May 21-June 20)
June	Pearl Alexandrite Moonstone	Health	Cancer (June 21-July 22)
July	Ruby	Contentment	Leo (July 23-Aug. 22)
August	Peridot Sardonyx	Married happiness	Virgo (Aug. 23-Sept. 22)
September	Sapphire	Clear thinking	Libra (Sept. 23-Oct. 22)
October	Opal Tourmaline	Hope	Scorpio (Oct. 23-Nov. 21)
November	Topaz	Faithfulness	Sagittarius (Nov. 22-Dec. 21)
December	Turquoise Zircon	Wealth	Capricorn (Dec. 22-Jan. 19)

Each gem has a separate article in *World Book*. Bloodstone, a form of chalcedony, is described in the article on **Chalcedony**.

person's astrological sign probably originated in Poland in the 1700's. It quickly became widespread. Through the years, jewelers have revised the list of birthstones. Today, many people wear their birthstones in jewelry to bring good luck. Christopher McIntosh

See also **Gem** (pictures).

Biscay, Bay of. See Bay of Biscay.

Biscayne National Park, *bihs KAYN,* lies in the upper Florida Keys near Miami. It includes narrow islands that separate Biscayne Bay from the Atlantic Ocean. It also includes the adjoining waters and submerged lands of the bay and ocean (see **Florida** [political map]). The islands have many tropical plants and are a nesting place of rare birds. The park includes the northernmost living coral reef along the Atlantic coast. The area was authorized as a national monument in 1968 and became a national park in 1980. For its area, see **National Park System** (table: National parks).

Critically reviewed by the National Park Service

Bishkek, *BEESH kehk* (pop. 626,000), is the capital and largest city of Kyrgyzstan, a country in central Asia. Bishkek lies in the Chu River valley in northern Kyrgyzstan. For location, see **Kyrgyzstan** (map).

Bishkek is a modern city with wide boulevards and many parks. It is Kyrgyzstan's economic and cultural center. Major industries include food processing and the manufacture of agricultural machinery and textiles. The city is the home of Kyrgyz State University and of several museums, theaters, and musical establishments.

In 1825, a local ruler built a fortress where Bishkek now stands. The fortress and its neighboring city were called Bishkek (also spelled "Pishpek"). Russians captured the area in the 1860's. The Soviets renamed the city *Frunze* in 1926, when Kyrgyzstan became a Soviet republic. The city's name was changed back to Bishkek in early 1991, when Kyrgyzstan declared itself independent from the Soviet Union. Nancy Lubin

Bishop, in some Christian churches, is a high-ranking official who administers an area containing a number of churches. The word *bishop* comes from a Greek word meaning *overseer.* The Anglican, Eastern Orthodox, Roman Catholic, and some other churches have bishops, as do certain Lutheran and Methodist groups.

Bishops are appointed or elected, depending on their church. In the Anglican, Eastern Orthodox, and Roman Catholic churches, each bishop administers a district called a *diocese.* These churches teach that only bishops possess full priesthood and, therefore, only they can ordain clergy and perform certain other priestly functions. Such churches consider bishops the successors of the apostles of Jesus Christ. This relationship is called *apostolic succession.* In the Lutheran and Methodist churches, all ministers, including bishops, have equal rank. Robert S. Ellwood, Jr.

See also **Archbishop; Roman Catholic Church** (Bishop and diocese).

Bishop, Billy (1894-1956), a Canadian flier, was a famous World War I pilot. He received credit for shooting down 72 German aircraft, but some historians have questioned that number. In 1917, he won the Victoria Cross, the highest award for valor in the British armed services. He also won the Distinguished Service Medal. After the war, he became a mining and oil executive in Canada. In World War II (1939-1945), he was a Royal Canadian Air Force air marshal in charge of recruitments.

William Avery Bishop was born at Owen Sound, Ontario. He was trained at the Royal Military College, Kingston, Ontario. He went to France with the Canadian Expeditionary Force and transferred to the British Royal Flying Corps in 1915. Alfred Goldberg

Bishop, Elizabeth (1911-1979), an American poet, wrote poems that offer exquisitely detailed descriptions of landscapes, animals, and objects. But her seemingly calm, objective style can be deceptive, because many of her poems contain deep emotional undercurrents. Her emphasis on outward appearance and precise detail is a way of controlling and containing intense feelings of fear, anxiety, loss, and desire.

Bishop often explored the way in which travel can make the familiar seem strange, and the strange seem familiar. In poems about maps, pictures, foreign countries, and domestic scenes, Bishop showed how easily the world can become puzzling, mysterious, even threatening. But she also showed how we can find ways to live in the world with a slightly ironic sense of comfort and belonging.

Stylistically, Bishop's poems display a relaxed, conversational tone, though many are written in difficult verse forms. Bishop sometimes spent years revising a single poem, yet her language always sounds fresh and spontaneous.

Bishop was born in Worcester, Massachusetts. She won the 1956 Pulitzer Prize for poetry for *Poems: North and South—A Cold Spring* (1955). *The Complete Poems: 1927-1979* was published in 1983, and *The Collected Prose,* in 1984. Roger Gilbert

Bismarck, *BIHZ mahrk,* North Dakota (pop. 55,532; met. area pop. 94,719), is the state capital and a medical, retail, and transportation center. It is a shipping center for the farm and ranch region of southwest North Dakota. It also serves as the headquarters for most mining activities in the western part of the state. It is on the east bank of the Missouri River, about 170 miles (274 kilometers) south of the Canadian border (see **North Dakota** [political map]). It is the seat of Burleigh County. Products include foods and farm machinery. The State Historical Society museum and library are in the Heritage Center. Bismarck State College overlooks the city on a bluff above the Missouri River. The University of Mary and the North Dakota State Penitentiary, which holds a prison rodeo every year, are on the outskirts of the city.

Settlers founded Bismarck in 1872 and called it *Edwinton.* Later, they changed the name to *Bismarck,* in honor of the German statesman Otto von Bismarck. Bismarck became a railroad center and supply point for the Black Hills gold mines in 1873. It became the capital of the Dakota Territory in 1883 and of North Dakota when statehood was granted in 1889. Douglas C. Munski

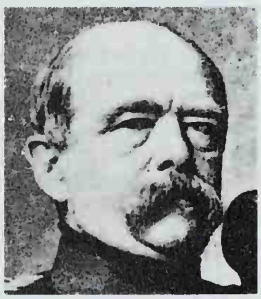
See also **North Dakota** (pictures).

Bismarck, *BIHZ mahrk,* was a German battleship that was sunk in one of the most important naval actions of World War II. The *Bismarck* was one of the most powerful battleships afloat. It displaced over 45,000 long tons of water and had eight 15-inch guns. A long ton is equal to 2,240 pounds or 1.016 metric tons. Germany planned to use the ship to raid Atlantic Ocean shipping lanes.

British cruisers sighted the *Bismarck* in the Denmark Strait, between Greenland and Iceland, on May 23, 1941. The next day, the *Bismarck* sank the British battle cruiser *Hood* and damaged a new British battleship off the coast of Greenland. Every available British warship joined in a chase of the ship. The British sighted the *Bismarck* near France on May 26. British airplanes attacked the ship, and five destroyers fired at it all night. Two battleships and a cruiser attacked it the next morning. That same morning, it sank about 600 miles (970 kilometers) off the French coast. American researchers found the ship in 1989. An inspection showed that the Germans may have sunk the *Bismarck* to keep the British from seizing it. Theodore Ropp

Bismarck, *BIHZ mahrk,* **Otto von** (1815-1898), Prince Bismarck-Schönhausen, was a Prussian statesman who united the German states into one empire. He declared that the great problems of his time must be settled by "blood and iron" instead of by speeches and resolutions.

Early life. Otto Eduard Leopold von Bismarck was born in Schönhausen, in the district of Magdeburg. The son of a noble family, he studied law at the universities of Göttingen and Berlin and was admitted to the bar in 1835. Bismarck served in the army as a lieutenant of the Life Guards and then returned to his family estates. In 1847, he was elected to the Prussian Diet. During 1849, his speeches in the Prussian parliament against revolutionaries attracted the attention of King Frederick William IV. Bismarck made plans for the future German empire as a representative of Prussia in the Diet of the German Confederation from 1851 to 1859. He served as ambassador first to Russia and then to France. He was called back to Prussia in 1862 to become prime minister and secretary of foreign affairs.



Brown Bros.

Otto von Bismarck

Bismarck's wars. Bismarck fought three wars to unify the German states. They were against Denmark in 1864; the Seven Weeks' War against Austria in 1866; and the Franco-Prussian War of 1870-1871. Near the end of the Franco-Prussian War, the king of Prussia was crowned Wilhelm I, emperor of Germany. Bismarck became chancellor and the head of the government of the new German empire. He was soon known as the "Iron Chancellor."

Bismarck's diplomacy. Bismarck's success in attaining German unity and national power was based on an effective military policy, extraordinary political cunning, and considerable diplomatic skill. He devoted his skills to the establishment of treaties that fortified the position of Germany in Europe. He created the Triple Alliance with Austria-Hungary and Italy, which lasted until World War I (1914-1918). He saw that the position of Germany in Europe might one day be endangered and made a treaty with Russia that guaranteed Germany's neutrality in case of an attack on Russia. He made peace with Russia and the isolation of France the cornerstones of his policy. He also established the principle that Germany should never fight a two-front war.

Wilhelm II, who became emperor in 1888, was jealous of Bismarck's fame. He forced the aged chancellor to resign in 1890. Bismarck then retired to his estates at Friedrichsruh. Otis C. Mitchell

Related articles in *World Book* include:

Berlin, Congress of
Franco-Prussian War
Prussia
Seven Weeks' War
Wilhelm

Bismarck Archipelago, *BIHZ mahrk AHR kuh PEHL uh goh,* is a group of islands in the southwest Pacific Ocean. The islands lie northeast of New Guinea and are part of the nation of Papua New Guinea (see **Papua New Guinea** [map]). The Bismarck Archipelago consists of more than 200 islands and has a land area of about 18,780 square miles (48,640 square kilometers). The two largest islands are New Britain, which covers 14,093 square miles (36,500 square kilometers); and New Ireland, with an area of 3,340 square miles (8,651 square kilometers). Other main islands include Manus and New Hanover. Manus is the largest of the Admiralty Islands, which are part of the archipelago. Most of the other islands in the Bismarck Archipelago are much smaller.

New Britain, New Ireland, and Manus have rugged mountain ranges and dense forests. New Britain features volcanoes. Many of the small islands are flat. Some are *atolls* (ring-shaped coral reefs). Located near the equator, the Bismarck Archipelago has a hot, humid climate. At sea level, average temperatures range from 75 to 88 °F (24 to 31 °C).

The Bismarck Archipelago has a population of about 430,000. About 70 percent of the people live on New Britain, and about 20 percent on New Ireland. Most of the people are Melanesians, a dark-skinned people with

black, woolly hair. The population also includes several hundred Chinese and Europeans. Most of the people live in small rural villages near the sea. Rabaul—on New Britain—is the largest urban community. It has about 15,000 people. The Melanesians speak many local languages. To communicate with members of different language groups, they use a widely understood language called *pidgin English* (see **Pidgin English**).

Most of the islanders fish, farm, and raise chickens and pigs for a living. They grow such crops as coconuts, sweet potatoes, taro, and yams for their own use. Islanders also produce *copra* (dried coconut meat), coconut oil, palm oil, cocoa, coffee, and timber for export.

In 1528, the Spanish explorer Alvaro de Saavedra became the first European to see parts of the Bismarck Archipelago. Germany claimed the islands in 1884 and named them after the German chancellor Otto von Bismarck. Australian troops captured the islands in 1914, during World War I (1914-1918). Japanese forces occupied the islands from 1942 to 1945, during World War II (1939-1945). After the war, Australia regained control. In 1975, the islands became part of the newly independent nation of Papua New Guinea. Robert Langdon

Bismuth, *BIHZ muhth,* is a brittle, white metal with a pink tint. It is found free in nature and in such ores as bismuth glance and bismite. Bolivia has the largest deposits of the metal. However, bismuth is generally obtained as a by-product in refining lead, copper, tin, silver, and gold ores, especially in the United States.

More than half the world's bismuth is used as a metal or in alloys. Bismuth is mixed with lead, tin, or iron to form *fusible metals,* which melt at low temperatures. In a steam boiler, for example, safety plugs made of these alloys will melt and let the steam escape before the pressure increases enough to burst the boiler. Similar plugs are used in automatic sprinkler systems. Heat from a fire melts the plugs and turns on the system. In electrical fuses, metal strips of these alloys melt when the electric current is too high.

Bismuth is also used in foundries and in nuclear reactors. Bismuth alloys give sharp impressions when they are used to make objects by casting in molds. Because bismuth does not absorb neutrons readily, melted bismuth is used to carry radioactive fuel to the core of certain nuclear reactors. It also helps cool the reactor.

Bismuth and its compounds have uses in medicine as well. For example, bismuth carbonate and bismuth subnitrate are prescribed for diarrhea, enteritis, gastric ulcers, and certain skin disorders. Bismuth compounds are also used in making cosmetics and certain drugs. But some medical experts warn against using certain substances containing bismuth because these substances have been found to cause toxic reactions.

The chemical symbol of bismuth is Bi. The element's atomic number is 83, and its atomic weight is 208.980. Bismuth melts at 271.3 °C and boils at 1560 °C (± 5 °C). Its density is 9.747 grams per cubic centimeter at 20 °C.

Raymond E. Davis

Bison. See **Buffalo** (animal).

Bissau, *bih SOW* (pop. 109,214), is the capital, chief port, and largest city of Guinea-Bissau. The city lies on the Atlantic Ocean, at the mouth of the Geba River on the coast of West Africa (see **Guinea-Bissau** [map]).

The Portuguese founded Bissau as a fort in 1765. From 1941 to 1974, Bissau was the capital of Portuguese Guinea, an overseas province of Portugal. The province became the nation of Guinea-Bissau in 1974. Bissau serves as the country's center of commerce, industry, and foreign trade. The city's main industry is the processing of such foods as coconuts and rice, which are grown in Guinea-Bissau. Lansiné Kaba

Bitter root, the state flower of Montana, is a small perennial plant. It grows from Montana to Arizona and west to the Pacific Coast. The plant has a long root that is good to eat, though it tastes bitter. Indians often used the root for food. Bitter root is sometimes called tobacco root because while being cooked it gives off a tobaccolike odor. The bitter root plant has juicy leaves, a fleshy stalk, and a single rose-colored or white flower.

The Bitterroot Mountain Range, between Montana and Idaho, was named for this plant. Also named for bitter root are a forest, a river, and a beautiful valley. All are in Montana and Idaho.

Scientific classification. Bitter root belongs to the purslane family, Portulacaceae. It is *Lewisia rediviva.* W. Dennis Clark

Bittern is any of about 13 species of marsh-dwelling birds in the heron family. Bitterns are found throughout the world, except in Antarctica and the northernmost parts of Asia, Europe, and North America, and on certain oceanic islands. Two species, the American bittern and the least bittern, live in North America.

The American bittern inhabits marshlands from Central America to southern and central Canada. This bird measures from 23 to 34 inches (58 to 86 centimeters) long. Its neck and legs are fairly long, but shorter than those of herons. It has a large, sharply pointed bill. The upper parts of its body are brown with streaks and flecks of buff and black. The underparts are pale buff with brown stripes.

An American bittern generally builds a crude nest on a mat of floating vegetation, among reeds and cattails. There, it lays three to five brownish eggs. Except at nesting time, the bird lives mainly alone. It often stands motionless in the marshes, watching for the fish, frogs, mice, and insects on which it feeds. To escape notice,

WORLD BOOK illustration by Trevor Boyer, Linden Artists Ltd.

The American bittern lives in marshlands.

the bird points its bill upward and stands still. Then it can hardly be seen among the reeds because of its colors. The call of the American bittern sounds like "pump-er-lunk, pump-er-lunk."

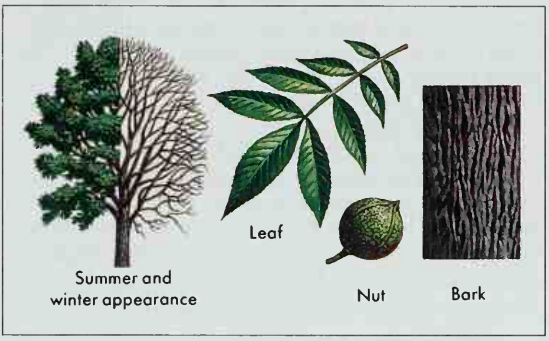
The least bittern inhabits marshlands from southeastern Canada to northeastern South America. The smallest of all bitterns, it measures only 11 to 14 inches (28 to 35 centimeters) long. A few least bitterns are covered with reddish-brown feathers. Most, however, have buffy underparts and wing patches, with greenish-black feathers on the top of the head and the back. The least bittern's habits are similar to those of the American bittern.

Scientific classification. Bitterns belong to the heron family, Ardeidae. The scientific name for the American bittern is *Botaurus lentiginosus.* The least bittern is *Ixobrychus exilis.*

James J. Dinsmore

See also **Bird** (picture: Birds of Central and South America); **Heron.**

Bitternut hickory, also called *swamp hickory,* is a medium or large hickory tree with bitter-tasting nuts. It often grows in low, wet woods but can be found in drier areas. It is found from New Hampshire to Minnesota and south to Florida and Texas. The leaves of this tree usually have seven or nine pointed leaflets. The smooth, round nut has a thin shell that splits into four narrow sections. The plump, white kernel is sometimes eaten by wildlife but not by people. The wood of the bitternut hickory is used in making furniture.



WORLD BOOK illustration by John D. Dawson

The bitternut hickory gets its name from the bitter taste of its smooth, round nuts. The leaves usually have seven or nine pointed leaflets. The tree is also called the *swamp hickory.*

Scientific classification. The bitternut hickory belongs to the walnut family, Juglandaceae. Its scientific name is *Carya cordiformis.*

Michael J. Baranski

See also **Hickory.**

Bitters is the term for certain bitter liquids extracted from herbs, leaves, barks, *rhizomes* (underground stems), roots, or flower heads. People generally take bitters as a tea to improve the appetite, aid digestion, or as a tonic. Bitters are also used to flavor certain alcoholic drinks. Common types of bitters include Angostura, cinchona, and hops.

James E. Simon

Bittersweet is the name of two unrelated vinelike plants. One kind is *American bittersweet,* also called *false bittersweet,* and the other is *European bittersweet,* or *woody nightshade.* Both kinds of plants are climbers that grow in moist, wooded areas and along fences and roadsides.

E. R. Degginger

American bittersweet seeds have bright red coverings.

American bittersweet climbs as high as 20 feet (6 meters). It has a woody stem, small greenish flowers, and oval leaves. Its seeds have a bright red covering and are enclosed in a yellow seedcase. After the leaves have withered in late autumn, the seedcases split open, producing fruit clusters of contrasting red and yellow. The contrasting colors give the plant an almost artificial appearance, resulting in its sometimes being called *waxwork.* People frequently use the fruit clusters in floral arrangements. American bittersweet grows wild from North and South Carolina to Quebec, westward to the Rocky Mountains.

European bittersweet seldom climbs more than 8 feet (2.4 meters) high. Its stem is woody only near the ground. This plant also has oval leaves. However, many of them have small, round lobes at their base. The flowers range from violet to pale blue, or, rarely, white. In late summer, the plant produces bright red berries. Both the berries and leaves are poisonous if eaten. European bittersweet is native to Europe and Asia. It was brought to North America and now grows wild throughout much of the northern United States.

Scientific classification. American bittersweet is in the staff-tree family, Celastraceae. Its scientific name is *Celastrus scandens.* European bittersweet belongs to the nightshade family, Solanaceae. Its scientific name is *Solanum dulcamara.*

David S. Seigler

Bitumen, *buh TOO muhn,* is a light brown to black noncrystalline solid or semisolid made up of hydrogen, carbon, and small amounts of sulfur, oxygen, and nitrogen. It occurs naturally as asphalt and as a crude oil that is too thick to flow freely at room temperature. It is also produced from certain crude oils or coals. Manufacturers use bitumen in fuels, paints, and paving and roofing materials, and in waterproofing and lining materials used in construction. They also make petroleum coke from bitumen. Bitumen as crude oil is slightly heavier than water. This bitumen can be removed from the ground by heating it to make it flow to a well.

Bituminous (soft) coal is the chief solid fuel used for heating. It is also the main raw material for *coke,* a substance used to convert iron ore into metallic iron.

W. Simon Tortike

See also **Bituminous sands; Coal.**

Bituminous sands, *buh TOO muh nuhs,* also called *tar sands,* are deposits of sand that contain *bitumen.* This bitumen is a gluelike, black substance used to produce coke, gas, and oil. Bitumen makes up as much as 18 percent of the weight of bituminous sands. The world is estimated to have from 1,800 billion to 2,300 billion barrels of crude oil available in bituminous sands. This amount is about three times as much as the estimated world reserves of petroleum.

When bituminous sand is mixed with steam and hot water, it produces a black, muddy substance called a *slurry.* As the sand settles in the slurry, the bitumen floats to the top as a foamy substance. The bitumen is then heated to produce coke, gas, and oil. The oil is distilled to produce such products as naphtha and kerosene. These products are treated with hydrogen to remove sulfur, which is a valuable by-product of this manufacturing process.

The Athabasca tar sands region in Alberta, Canada, has the largest bituminous sands deposit in the world. Two recovery plants at nearby Fort McMurray can produce more than 200,000 barrels of synthetic crude oil a day. W. Simon Tortike

See also **Petroleum** (pictures).

Bivalve. See **Shell** (Kinds of mollusk shells); **Mollusk.**

Bizet, *bee ZAY,* **Georges,** *zhawrzh* (1838-1875), a French composer, wrote *Carmen* (1875), one of the most popular operas of all time. This violent love story was severely criticized at first. Critics said the murder scene was inappropriate for the stage, and called the story obscene and its characters repulsive. They did not realize that Bizet had created true-to-life characters, rather than the usual opera types. He based *Carmen* on a novelette by the French author Prosper Mérimée (see **Mérimée, Prosper**).

Bizet was born in Paris and became a student at the Paris Conservatory just before his 10th birthday. At 14 he won a first prize for piano playing. Even before he graduated in 1857, he had written his *Symphony in C.* This work was neglected during Bizet's lifetime, and was not published until 1935.

Although Bizet was a brilliant pianist, his main interest was in composing, especially operas. He was an impulsive man, and started many works but completed only a few. His first important completed opera, *The Pearl Fishers* (1863), was poorly received. He gained his first recognition with his opera *The Young Girl of Perth* (1867). In 1872, Bizet wrote the incidental music for Alphonse Daudet's play *L'Arlésienne.* The two orchestral suites that were created from music from this play rank among Bizet's best compositions. His other important works include songs and pieces for solo piano.

Bizet's music is very melodic—tightly organized with relatively simple yet creative orchestral accompaniment. These features brought new freshness to music of his time. Stewart L. Ross

See also **Opera** (*Carmen;* picture: *Carmen*).

Bjerknes, *bih AIRK nehs,* **Vilhelm** (1862-1951), was a Norwegian physicist whose work led to the development of modern techniques for describing and predicting the weather. He and his students introduced the idea of the *front,* which is a boundary between masses of warm and cold air.

In 1898, Bjerknes used mathematical equations to describe what happens when regions of a fluid become lighter or heavier. He explained how light fluid rises and heavy fluid sinks, creating patterns of circulation. Bjerknes then applied this description to weather. In a sea breeze, for example, the circulation is the breeze, and the fluid is air. The lighter regions are masses of warm air, and the heavier regions are masses of cold air. He later used equations to predict the weather.

Bjerknes was born in Christiania (now Oslo), Norway. He received a doctor's degree in physics from the University of Oslo in 1892. Margaret A. LeMone

Bjoerling, *bih EHR lihng,* **Jussi,** *YOOS see* (1911-1960), was a Swedish operatic tenor who was famous for the elegance of his light, lyrical voice. Bjoerling was a leading tenor at the Metropolitan Opera in New York City for more than 20 years.

Bjoerling was born in Stora Tuna, Sweden, near Börlange. He began his career as a child singing with his father and two brothers in a group that was called the Bjoerling Male Quartet. He first studied singing with his father and then at the Royal Opera School in Stockholm. Bjoerling made his professional operatic debut in 1930 at the Royal Swedish Opera in Stockholm as Don Ottavio in *Don Giovanni.* He made his debut at the Metropolitan Opera in 1938 as Rodolfo in *La Bohème.* Thomas Bauman

Bjørnson, *BYURN suhn,* **Bjørnstjerne,** *BYURN STYEHR nuh* (1832-1910), was a Norwegian poet, novelist, and playwright. He won the Nobel Prize for literature in 1903. Bjørnson's work describes the Norwegian landscape and national character. His work also reflects his intense patriotism and political activity. Bjørnson was deeply involved in the political and moral controversies of his time.

During Bjørnson's lifetime, he was as popular as the great Norwegian dramatist Henrik Ibsen. However, Bjørnson's reputation has declined. His lyrical prose and poems about the Norwegian countryside are now considered his best work.

Bjørnson was born in Kvikne, near Trondheim, and grew up in an area known for its scenic beauty. His short novels *Synnøve Solbakken* (1857) and *Arne* (1858) portray Norwegian peasant life. In his best historical play, *Sigurd Slembe* (1862), he reconstructed the Norwegian past and inspired Norwegians with patriotism. In the late 1800's, Bjørnson became involved in the realism movement and wrote plays and novels about social issues of his time. His play *Paul Lange and Tora Parsberg* (1898) criticizes political intolerance. Niels Ingwersen

Black. See **Color.**

Black, Davidson (1884-1934), a Canadian anatomist and physical anthropologist, discovered and interpreted the fossilized bones that represent the extinct form of man known as *Sinanthropus pekinensis* (see **Peking fossils**). The first deposit was found close to the village of Zhoukoudian, near Beijing (also spelled Peking), China, in 1927.

Black was born in Toronto, Ontario, and graduated from the University of Toronto. He became professor of anatomy in the Beijing (China) Union Medical College in 1921. David B. Stout

Black, Hugo Lafayette (1886-1971), was an associate justice of the Supreme Court of the United States from 1937 to 1971. He became noted for defending the right

of free speech guaranteed in the First Amendment to the United States Constitution.

Black was born in Harlan, Alabama. He served as a Democratic United States senator from Alabama from 1927 to 1937. In the Senate, he vigorously supported President Franklin D. Roosevelt's New Deal policies. This support led to Black's nomination to the U.S. Supreme Court in 1937.

A month after Black became an associate justice, it was disclosed that he had once been a member of the Ku Klux Klan. The disclosure caused a national uproar. But on the court, Black strongly supported government protection of civil rights. Owen M. Fiss

Black, Joseph (1728-1799), a Scottish physician and chemist, first explained the nature of caustic and mild alkalis (hydroxides and carbonates), identified carbon dioxide as a distinct gas, and showed that gases could appear in solids. He developed the theory of latent heat. He was born at Bordeaux, France.

Black Americans. See African Americans.

Black and tan coonhound is a breed of dog that originated in America. It was developed during the 1700's by English colonists in Virginia for hunting raccoons and opossums. The black and tan coonhound is a descendant of the bloodhound and the American foxhound. It is the only coonhound breed recognized by the American Kennel Club.

Today, the black and tan coonhound is popular with hunters for tracking such game as deer, elk, and mountain lions. The dog has a short, thick, black coat with tan markings on the snout, chest, and legs. It stands from 23 to 27 inches (58 to 69 centimeters) tall and weighs from 50 to 60 pounds (23 to 27 kilograms).

Critically reviewed by the American Kennel Club

See also **Dog** (picture: Hounds).

Black Canyon of the Gunnison National Park lies in west-central Colorado. Its main feature is a steep, rugged canyon, through which the Gunnison River rushes in a series of churning rapids. Black Canyon's name comes from the fact that sunlight reaches the floor of the narrow canyon for only about an hour a day.

Scenic drives wind along the canyon's rims. The park also has hiking trails and campsites. Popular activities for visitors include trout fishing in the Gunnison River and rock climbing on the canyon walls.

Black Canyon of the Gunnison became a national monument in 1933. It was made a national park in 1999. For the area, see **National Park System** (table: National parks). For location, see **Colorado** (physical map).

Critically reviewed by Black Canyon of the Gunnison National Park

Black Caucus, Congressional, is an organization of African American members of the Congress of the United States. The caucus promotes the interests of blacks and other groups who it believes have been the victims of discrimination.

The Black Caucus pursues its goals largely by trying to influence legislation in Congress. The caucus has been especially influential in the House of Representatives. At times, its members have held important House leadership positions, particularly on House committees and subcommittees.

The Black Caucus was founded in 1970 by African American members of the House. Since then, almost all black members of Congress have belonged to the organization. The caucus's membership has consisted almost entirely of Democrats. Traditionally, the caucus has elected from among its members a chairperson, who serves one 2-year term.

In 1995, the Republican-controlled House eliminated government funding of 28 congressional caucuses, including that of the Black Caucus. Government funding had covered much of the caucus's budget. To continue operating, the caucus had to begin relying on the staffs of its members and on the work of volunteers.

Carol M. Swain

See also **Mfume, Kweisi.**

Black codes were state laws regulating the activities of blacks in the Southern United States after the American Civil War. When slavery was abolished in 1865, Southerners used black codes to retain control over blacks. The laws varied in strictness and detail from state to state. They restricted the civil rights of blacks and generally treated them as social and civil inferiors. Some forbade blacks to own land or carry arms. During the Reconstruction period between 1865 and 1877, the military governors who controlled the South suspended the black codes. In 1866, Congress passed the Civil Rights Act. The 14th Amendment to the United States Constitution, which protects the rights of blacks, was ratified in 1868. Nancy J. Weiss

See also **Reconstruction** (The black codes).

Black Death. See **Plague.**

Black-eyed pea. See **Cowpea.**

Black-eyed Susan, also called *yellow daisy,* is a small wildflower with orange-yellow rays and purple-black, cone-shaped centers. These flowers grow in dry fields and along roads from northern Mexico to southern Canada. One flower grows on each stem, and a plant may have many stems. The leaves are stiff and hairy, arranged alternately on the stem. These showy flowers bloom from May to October. The flowers are difficult to pick without pulling up the entire plant because the stems are tough. The plant may become a weed.

WORLD BOOK illustration by Robert Hynes

Black-eyed Susans

Anton A. Reznicek

Scientific classification. The black-eyed Susan belongs to the composite family, Compositae. Its scientific name is *Rudbeckia hirta.*

Black-footed ferret. See **Ferret.**

Black Forest is a mountain district in southwestern Germany, covered with forests of dark fir and spruce trees. The German name of the region is *Schwarzwald,* which means *black forest.* The northern part consists of a sandstone plateau. Granite mountains cover the southern part. The highest peak is Feldberg (4,900 feet, or 1,490 meters). The Rhine River flows for almost 100 miles (160 kilometers) past the western edge of the forest. The Danube River rises in the region. For the location of the Black Forest, see **Germany** (terrain map).

The region is noted for its mineral springs. Many health resorts, including the famous city of Baden-

Baden, are located near these springs. The forests yield much lumber. Granite quarries are located in the south part of the Black Forest.

The people of the Black Forest manufacture toys, cuckoo clocks, radios, and musical instruments. They have kept many old customs and traditions. The Black Forest is the scene of many ancient German legends and fairy tales. A part of Mark Twain's book *A Tramp Abroad* describes the Black Forest. John W. Boyer

See also **Europe** (picture: The Black Forest).

Black Friday refers to two different Fridays in the history of the United States, each of which led to a financial emergency. The first Black Friday was on Sept. 24, 1869. Financiers Jay Gould and James Fisk had caused the price of gold to rise sharply by buying large amounts of it in New York City. They planned to then sell their gold for a big profit. The rise in gold prices caused a financial panic. To end the panic, President Ulysses S. Grant ordered the U.S. Treasury to sell $4 million of the government's gold reserves. The sale caused the price of gold to fall sharply. Many people who had speculated on the rising price lost heavily, but Gould and Fisk made about $11 million. Gould had been warned of the Treasury's intentions and sold his gold before the crash. Fisk shared in Gould's profits and refused to honor contracts he had made to buy gold at high prices.

The second Black Friday was on Sept. 19, 1873. On this day, the New York Stock Exchange reported the collapse of the investment banking firm of Jay Cooke & Company. The company floundered after investing too heavily in railroad securities. Its failure affected the entire stock market. The resulting Panic of 1873 led to a depression that lasted most of the decade. It was the worst economic crisis in U.S. history up to that time. Michael Perman

See also **Grant, Ulysses S.** (Political corruption; The Panic of 1873).

Black gold. See **Petroleum**.

Black Hawk (1767-1838) was a Sauk Indian chief. He was noted for his struggle against the westward movement of the white settlers in Illinois (see **Sauk Indians**).

Black Hawk was born at the mouth of the Rock River in Illinois, and became a chief of his tribe in 1788. The Sauk and Fox tribes agreed in 1804 to give the United States their lands east of the Mississippi River. But Black Hawk refused to accept the contract. He declared that the chiefs had been given intoxicating liquors before they signed the documents.

During the War of 1812, Black Hawk and about 500 of his warriors joined the British for a time (see **War of 1812**). By 1830, most of the Sauk and Fox Indians, led by Keokuk, had moved to a reservation west of the Mississippi River. In 1831, Black Hawk's band was forced to join them. But in 1832, he returned with his followers and fought the whites in what was known as the Black Hawk War. The Indians lost, and Black Hawk and his two sons were captured. They were kept in Fort Monroe until 1833, when they joined their tribe on a reservation near Fort Des Moines. Black Hawk's surrender marked the end of Indian-held lands in the Illinois region.

Black Hawk died on the reservation near Des Moines on Oct. 31, 1838. His body was placed in a small shelter in Indian fashion. Later his bones were removed to the Historical Society Building in Burlington, Iowa. Here they were lost in a fire that destroyed the structure. A 50-foot (15-meter) statue of Black Hawk by American sculptor Lorado Taft stands beside the Rock River near Oregon, Illinois. Donald W. Wanatee, Sr.

© Robert Frerck

Black Hawk, a Sauk Indian chief, led Sauk and Fox Indians against whites in the Black Hawk War in 1832. A statue of Black Hawk by the American sculptor Lorado Taft rises 50 feet (15 meters) beside the Rock River near Oregon, Illinois.

See also **Indian wars.**

Additional resources

Black Hawk. *Black Hawk's Autobiography.* Ed. by Roger L. Nichols. Ia. State Univ. Pr., 1999. Autobiography first published in 1833.

Bonvillain, Nancy. *Black Hawk.* Chelsea Hse., 1994. Younger readers.

Black Hills are a range of low mountains in southwestern South Dakota and eastern Wyoming. The region is a favorite vacation ground among tourists because of its beauty. The Black Hills cover 6,000 square miles (16,000 square kilometers). They rise from 2,000 to 4,000 feet (610 to 1,200 meters) above the surrounding plains.

The Black Hills were formed millions of years ago when pressure from below raised the crust of the earth into a huge dome. Erosion wore this dome into the gigantic rock stubs that are now called the Black Hills. The Sioux Indians called this region the Black Hills because pine forests covering the slopes looked black when seen from the plains.

The Black Hills region has many canyons, streams, and rock formations. Harney Peak (7,242 feet, or 2,207 meters) is the highest point in South Dakota. It overlooks Sylvan Lake. Other high peaks in the region include Terry Peak, Custer Peak, Parker Peak, and Crows Nest Peak. In the region are Mount Rushmore Memorial, Crazy Horse Memorial, Wind Cave National Park, and Custer State Park.

The Black Hills were once part of a reservation for the Sioux Indians. However, thousands of white settlers poured in after gold was found in 1874. The federal government took possession of the territory from the Sioux in 1877. Mining towns sprang up, the most noted of

which was Deadwood. Later, other minerals, such as silver, copper, and lead, were mined in the Black Hills. The pine forests were logged. Farmers began to raise crops. Tourism became a major industry for the region. Rapid City is the largest town in the Black Hills region. The Homestake Mine, one of the largest gold mines in the United States, is in Lead. Edward Patrick Hogan, Sr.

Related articles in *World Book* include:
Indian wars (The Sioux wars)
Mount Rushmore National Memorial
Rapid City
South Dakota (Land regions; pictures)
Wind Cave National Park

Black History Month is an annual observance, in February, of the past achievements and current status of African Americans. It coincides with the birthdays of the great black leader Frederick Douglass (February 14) and of Abraham Lincoln (February 12).

The idea for an observance honoring the accomplishments of African Americans led to the establishment of Negro History Week in 1926. It was proposed by Carter G. Woodson, a black historian known as the Father of Black History, and others. The observance became known as Black History Week during the early 1970's and was established as Black History Month in 1976.

The celebration is sponsored by the Association for the Study of African-American Life and History (ASALH). Woodson founded the organization in 1915 as the Association for the Study of Afro-American Life and History. Each year, the ASALH designates a theme. Special attention has also been paid to the growth of African American studies courses at schools across the country.

The ASALH produces Black History Month Study Kits to help schools, colleges, ASALH branches, and other organizations celebrate the observance. The ASALH also provides information about Black History Month through its publications. Critically reviewed by the Association for the Study of African-American Life and History

See also **African Americans** and its list of *Related articles;* **Association for the Study of African-American Life and History; Woodson, Carter G.**

Black hole is a region of space whose gravitational force is so strong that nothing can escape from it. A black hole is invisible because it even traps light. The fundamental descriptions of black holes are based on equations in the theory of general relativity developed by the German-born physicist Albert Einstein. The theory was published in 1916.

Characteristics of black holes. The gravitational force is strong near a black hole because all the black hole's matter is concentrated at a single point in its center. Physicists call this point a *singularity.* It is believed to be much smaller than an atom's nucleus.

The surface of a black hole is known as the *event horizon.* This is not a normal surface that you could see or touch. At the event horizon, the pull of gravity becomes infinitely strong. Thus, an object can exist there for only an instant as it plunges inward at the speed of light.

Astronomers use the radius of the event horizon to specify the size of a black hole. The radius of a black hole measured in kilometers equals three times the number of *solar masses* of material in the black hole. One solar mass is the *mass* (amount of matter) of the sun.

No one has yet discovered a black hole for certain. To prove that a compact object is a black hole, scientists would have to measure effects that only a black hole could produce. Two such effects would be a severe bending of a light beam and an extreme slowing of time. But astronomers have found compact objects that are almost certainly black holes. The astronomers refer to these objects simply as "black holes" in spite of the small amount of uncertainty. The remainder of this article follows that practice.

Formation of black holes. According to general relativity, a black hole can form when a massive star runs out of nuclear fuel and is crushed by its own gravitational force. While a star burns fuel, it creates an outward push that counters the inward pull of gravity. When no fuel remains, the star can no longer support its own weight. As a result, the core of the star collapses. If the mass of the core is three or more solar masses, the core collapses into a singularity in a fraction of a second.

Galactic black holes. Most astronomers believe that the Milky Way Galaxy—the galaxy in which our solar system is located—contains millions of black holes. Scientists have found a number of black holes in the Milky Way. These objects are in *binary stars* that give off X rays. A binary star is a pair of stars that orbit each other.

In a binary system containing a black hole, that object and a normal, visible star orbit one another closely. As a result, the black hole strips gas from the normal star, and the gas falls violently toward the black hole. Friction between the gas atoms heats the gas near the event horizon to several million degrees. Consequently, energy radiates from the gas as X rays. Astronomers have detected this radiation with X-ray telescopes.

Astronomers believe that a number of binary star systems contain black holes for two reasons: (1) Each system is a source of intense and variable X rays. The existence of these rays proves that the system contains a compact star—either a black hole or a less compact object called a *neutron star.* (2) The visible star orbits the compact object at such a high velocity that the object must be more massive than three solar masses.

Supermassive black holes. Scientists believe that most galaxies have a *supermassive black hole* at the center. The mass of each of those objects is thought to be between 1 million and 1 billion solar masses. Astronomers suspect that supermassive black holes formed several billion years ago from gas that accumulated in the centers of the galaxies.

There is strong evidence for a supermassive black hole at the center of the Milky Way. The clearest indication of its presence is that several dozen stars are moving very rapidly near the galactic center. The fastest one is moving at a speed of 870 miles (1,400 kilometers) per second. The motion of the stars leads astronomers to conclude that an unseen object weighing 2.6 million solar masses lies at the galactic center. Other evidence shows that the object's radius is less than 300 billion miles (480 billion kilometers). The only known object that could have that mass and be so compact is a black hole. Jeffrey E. McClintock

See also **Neutron star; Relativity; Star** (Fusion in stars).

Black Hole of Calcutta was the scene of a disputed incident that took place in India in 1756, during a battle between British and Indian troops. The Indians captured

a British fort in Calcutta (now Kolkata) and locked their prisoners overnight in a room approximately 14 feet (4.3 meters) wide and 18 feet (5.5 meters) long. An uncertain number of prisoners suffocated in the room, which became known as the *Black Hole of Calcutta.* John Holwell, a British survivor of the incident, claimed that 146 people were held in the room and 123 died.

Most English historians accepted Holwell's story, which was used to promote anti-Indian feelings. Indian historians rejected Holwell's figures. Later research showed that no more than 43 of the British prisoners were unaccounted for. The number of deaths probably did not exceed 15. Brijen K. Gupta

Black humor is a literary term that refers primarily to a kind of bitter and often outrageous satire. Much black humor is directed against greed, narrow-mindedness, complacency, and hypocrisy. Black humor frequently satirizes society's institutions, including government bureaucracies, the military, and large corporations, depicting them as dehumanizing organizations. Black humorists often attack the absurdity they see in life itself, as well as society's ills. The awareness of human mortality is basic to black humor, giving many of the works a desperate, even hopeless attitude.

Black humor as a movement became prominent in the 1960's. But critics have found elements of black humor in the writings of the English author Jonathan Swift and the French philosopher Voltaire in the 1700's and in the writings of some earlier authors. Features of black humor appear in the *Theater of the Absurd,* an experimental drama movement that emerged in France in the 1950's. A number of American writers have been called black humorists, including Joseph Heller and Kurt Vonnegut. A number of motion pictures exhibit elements of black humor, notably *Dr. Strangelove* (1964), directed by Stanley Kubrick. A number of comedians deal in material that can be called black humor. Arthur M. Saltzman

There is a biography in *World Book* for each person mentioned in this article. See also **Drama** (The Theater of the Absurd).

Black Kettle (1803?-1868) was a Cheyenne Indian chief. He became known for his attempts to live in peace with white settlers. But his people were the victims in two brutal massacres by white troops.

In November 1864, Black Kettle and his people settled along Sand Creek in what is now southeastern Colorado. Although the Indians had made an agreement with the governor, a force led by Colonel John M. Chivington attacked them on Nov. 29, 1864. Black Kettle escaped, but the soldiers killed nearly 300 Indian men, women, and children. Black Kettle moved to the Washita River near the site of present-day Cheyenne, Oklahoma. On Nov. 27, 1868, Lieutenant Colonel George A. Custer led a surprise attack on the Cheyenne camp. The soldiers killed Black Kettle and killed or wounded more than 100 of his people.

Black Kettle was born in the North Platte River Valley in what is now southern Wyoming. His Indian name was Moke-ta-ra-to. W. Jean Hurtado

Black lung is a potentially disabling lung disease that afflicts coal miners. The disease, also called *coal workers' pneumoconiosis,* is caused by the inhalation of coal dust over a long period. Accumulated coal dust irritates lung tissue and may destroy it. But defense mechanisms in the lungs remove nearly all the dust. Thus, black lung seldom develops in people who have worked in coal mines for less than 10 years.

Physicians diagnose black lung mainly by means of chest X rays. The disease has two main forms, *simple* and *complicated.* The simple form affects only small, scattered areas of the lung and generally has no symptoms. The complicated form damages or destroys a large part of the lung. It results from heavy exposure to coal dust, plus an unknown factor, and causes severe chest pain and shortness of breath. Complicated black lung may worsen even if the victim is no longer exposed to coal dust. It may lead to disability and death.

Black lung often occurs in combination with other diseases, such as bronchitis, emphysema, or tuberculosis. There is no treatment for black lung, but the disease can be prevented by minimizing dust inhalation. A United States government program, financed partly by the coal industry, pays benefits to miners disabled by black lung. Michael G. Levitzky

Black magic. See Magic (Kinds of magic).

Black market is the sale or distribution of goods or currency in violation of ceiling prices, quotas, rationing, and priorities established by a government. Anyone who buys or sells rationed goods or controlled currency through illegal channels or above the established ceiling prices becomes a dealer in the black market.

Black marketeers deal in secret. They are most successful in countries that cannot produce enough goods to supply all the people's needs. In times of emergency, such as a war, most governments set up systems of rationing so that everyone receives a fair share at legal prices. Black markets then spring up to sell goods to people who do not care how much they have to pay in order to have more of some luxury. Profits earned in the black market are often substantial.

Black marketing is illegal. A "gray market" deals in the same kinds of goods, at exorbitant prices, but its operators manage to stay within the law. Jay Diamond

See also **Rationing**.

Black Muslims is a name that has been used for members of several related religious groups in the United States. Almost all the members have been African Americans. Two of the groups have been known as the Nation of Islam. They include the original Black Muslim organization, which operated from 1930 to 1975, and a group founded by American minister Louis Farrakhan in 1977. The name Black Muslims is widely used today even though members of the groups have rejected the name.

The original Black Muslims organization was founded in Detroit in 1930 by Wallace D. Fard (or Wali Farad), a silk salesman. He taught his followers that their "true religion" was not Christianity, but Islam, the "religion of the black man" of Asia and Africa. Fard stressed "knowledge of self" as a requirement for achieving black liberation. He established Temple of Islam No. 1 in Detroit.

Fard's organization accepted only blacks as members. Its leaders taught that whites were "devils," and they called for the separation of blacks and whites. The organization combined some aspects of Islam with doctrines of black nationalism.

After Fard mysteriously disappeared in 1934, his chief lieutenant, Elijah Muhammad (formerly Elijah Poole), be-

came the Nation of Islam's leader. In 1936, he established its headquarters at Temple No. 2 in Chicago. Muhammad claimed that Fard was Allah, and he was Allah's messenger. He continued Fard's teachings, which stressed three factors: (1) the need for blacks to establish a separate nation in the United States, (2) the need to recover an acceptable identity, and (3) the need for economic independence.

In the 1950's and early 1960's, Malcolm X was the most important spokesman for the Nation of Islam. He converted to the movement while in prison in 1947. The years from Malcolm's release from prison in 1952 to his assassination in 1965 marked the Nation's greatest growth and influence. Malcolm left the Nation of Islam in 1964 and converted to Sunni Islam, a traditional branch of Islam followed by most African Muslims.

After Elijah Muhammad died in 1975, his son Warith (formerly Wallace) Deen Mohammed (sometimes spelled Muhammad) was chosen as the leader. He rid the group of its black nationalistic characteristics, announcing that whites were no longer "devils" and could join his organization. He also led his followers toward Sunni Islam. The group's name was changed from Nation of Islam to the World Community of Al-Islam in the West, then to the American Muslim Mission, and finally, in 1997, to the Muslim American Society.

In 1977, Louis Farrakhan led a group of discontented followers in reestablishing the Nation of Islam. The group continued the black nationalist and separatist teachings of Elijah Muhammad. In 1997, Farrakhan began to move closer to orthodox Sunni Islam. He adopted the orthodox Friday worship service, prayer posture, and fasting. These measures helped end 25 years of separation and hostilities between Farrakhan and Mohammed. The two men declared their unity at the second International Islamic Conference in Chicago in February 2000. However, they continue to lead separate movements. Lawrence H. Mamiya

See also **African Americans** (Black militancy); **Farrakhan, Louis; Malcolm X; Muhammad, Elijah; Muslims; Nation of Islam.**

Additional resources

Banks, William H. *The Black Muslims.* Chelsea Hse., 1996. Younger readers.

Lincoln, C. Eric. *The Black Muslims in America.* 3rd. ed. 1994. Reprint. Africa World Pr., 1996.

Black Panther Party was a radical political organization in the United States. The Black Panther Party for Self-Defense was founded in Oakland, California, in 1966 by Huey P. Newton and Bobby Seale. A chief goal was to protect African Americans from police actions that many blacks considered brutality. In time, the Black Panthers dropped the "Self-Defense" label from their name. The organization became more of a Marxist-Communist group that favored violent revolution, if necessary, to bring about changes in society.

In the mid-1960's, the Black Panthers called for neighborhood control of such services as education and law enforcement. The Panthers supported the use of guns—both for self-defense and to retaliate against people believed to be oppressing the poor. Hostility between the Panthers and the police led to several shoot-outs.

During the late 1960's, the Black Panthers began to work with white radical and revolutionary groups that shared their goals. This policy brought the Panthers into disagreement with some African American groups that regarded the struggle of blacks as chiefly racial. According to the Panthers, the basic problem was economic exploitation of both blacks and whites by profit-seeking capitalists. The Panthers called for a fairer distribution of jobs and other economic resources.

In 1973, Seale ran for mayor of Oakland. Although he lost, he won a third of the votes. This campaign indicated the Panthers were turning toward more traditional political means to achieve their goals. They also began to stress service to the black community. The Panthers ran a free food program, health clinic, and elementary school in the Oakland area. By the mid-1970's, however, the party had ceased to exist. Charles V. Hamilton

See also **Cleaver, Eldridge.**

Black Prince. See **Edward** (The Black Prince).

Black Sea is a large body of water bounded by Bulgaria, Ukraine, Russia, Georgia, Turkey, and Romania. The Bosporus Strait, the Sea of Marmara, and the Dardanelles Strait connect it with the Mediterranean Sea (see **Bosporus; Dardanelles**). One reason for its name is that heavy fogs make the Black Sea look dark in winter. Another reason for the name may be that sudden storms form frequently over its waters.

The Black Sea covers about 173,000 square miles (448,000 square kilometers). Its deepest bed is 7,238 feet (2,206 meters) below the surface. Important rivers that empty into the Black Sea include the Danube, Don, Dnestr, and Dnepr. The sea contains only a few small islands. North of Kerch Strait is the Sea of Azov, which is really a large bay of the Black Sea (see **Azov, Sea of**).

Fisheries on the Black Sea yield herring, mackerel, pike, perch, and bream. Porpoises are also hunted on the Black Sea. Freight carried on the sea includes grain, timber, petroleum, cement, and manganese.

The Black Sea provides ships with access to the Mediterranean Sea. Important ports on the Black Sea include Odessa, Mykolayiv, Kherson, and Sevastopol in Ukraine; Novorossiysk and Sochi in Russia; Sukhumi and Batumi in Georgia; Trabzon and Samsun in Turkey; Burgas and Varna in Bulgaria; and Constança in Romania. Ice hinders shipping in January and February. Control of the

WORLD BOOK map

Location of the Black Sea

straits to the Mediterranean long has been disputed.

In World War II, Germany captured Sevastopol, the largest naval base, and several other ports. The Soviet Union recaptured these bases in 1943 and 1944. Before its breakup in 1991, the Soviet Union operated a fleet in the Black Sea. After the breakup, the fleet came under the joint command of Russia and Ukraine. In 1997, Russia and Ukraine agreed to divide the fleet. Russia received about 80 percent of the ships and agreed to lease docking space from Ukraine at Sevastopol.

Leszek A. Kosiński

See also **Romania** (Recreation; Land and climate; picture: Crowds of vacationers).

Black Seminole were African slaves who escaped plantations in the United States to live among the Seminole Indians in Florida in the late 1700's and early 1800's. They adopted some Seminole ways of life, including language and dress, but they also preserved elements of their own culture. The Black Seminole built their own villages, farmed their own land, and intermarried with the Seminole. Some went on to become notable leaders.

Granger Collection

Black Seminole were African slaves who escaped from plantations in the United States to live among the Seminole Indians in Florida. They adopted Seminole language and dress.

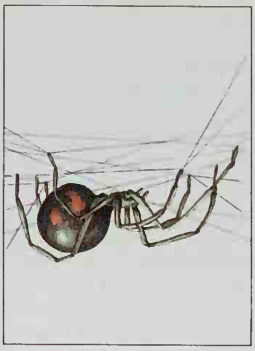
The United States sought to remove all the Seminole from Florida to the Indian Territory in present-day Oklahoma. After conflicts with the U.S. Army, most had moved west by 1842. But there, they were forced to share their land with their rivals, the Creek Indians.

In the Indian Territory, the Black Seminole suffered years of hardship and harassment from other Indians and slave-hunters, who often kidnapped them and returned them to slavery. In 1850, many Black Seminole escaped across the Rio Grande to Mexico. In Mexico, they prevented Indian raiding parties and slave-hunters from entering the territory. They became well-known for their courage, superb marksmanship, and tracking skills.

In 1870, the U.S. Army recruited Black Seminole to be scouts in special cavalry units to fight Indian raiders from the Southwestern United States and Mexico. They were extremely effective, engaging in a dozen battles without losing a single scout. Four Black Seminole scouts received Medals of Honor for bravery. The scouts were disbanded in 1914. Despite their service, the U.S. government evicted the Black Seminole who had made their homes on government land in Texas.

Nudie Eugene Williams

Black widow is the most dangerous spider in the United States. Its poisonous bite can cause illness and severe pain. Deaths have been reported. But they usually result from complications and not from the bite itself. The black widow got its name because the female sometimes kills the male after mating. Scientists believe only the female is dangerous to people.



WORLD BOOK illustration by Shirley Hooper, Oxford Illustrators Limited

Female black widow

The female has a shiny black body about the size of a pea and is about 1 $\frac{1}{2}$ inches (3.8 centimeters) long with legs extended. The underside of her abdomen has a red or yellow mark in an hourglass shape. The male is about a fourth as large as the female.

The black widow weaves shapeless webs in dark nooks. It may be found in the corners of barns, sheds, and other buildings near homes. The spider hangs upside down in its web, and it hides there when frightened. However, it may bite if caught in clothing. The black widow is most common in the South, but it is found in nearly every state and in Canada. The *brown widow* and the *red widow,* found in Florida, are closely related to the black widow.

James E. Carico

Scientific classification. The black widow belongs to the family Theridiidae. Its scientific name is *Latrodectus mactans.*

See also **Spider** (Tangled-web weavers).

Blackbeard (? -1718), a British pirate, was one of the most famous villains in the history of the sea. He received his name from his habit of braiding his long, black beard and tying the braids with ribbon. Few pirates have looked and acted as fierce as Blackbeard.

Blackbeard carried three braces of pistols. He made himself look devilish in the thick of fighting by sticking long, lighted matches under his hat, framing his face in fire. If action was slow, Blackbeard stirred things up by lighting pots of sulfur in his own ship, or shooting off pistols beneath the table while entertaining friends in his darkened cabin. His journal states that confusion and plotting developed if his men were sober, but all went well when they had enough rum.

Blackbeard terrorized the Carolina and Virginia coasts during 1717 and 1718 in his ship, the *Queen Anne's Revenge.* In 1717, he blockaded Charleston, South Carolina. He captured ships in the harbor and seized citizens for ransom. Blackbeard left after he received a chest of medicine as ransom. After this raid, he ran his ship aground near Cape Fear, North Carolina. Blackbeard then received a general pardon from Governor Charles Eden of North Carolina, whom he probably bribed. Life on land was not for Blackbeard, and he quickly returned to the sea.

Blackbeard took such a toll of shipping and created so much terror along the American coast that Virginia and Carolina planters organized against him. Virginia's governor sent the ship H.M.S. *Pearl* out to take him alive or dead. Blackbeard was caught on Nov. 21, 1718, near

Ocracoke Inlet, off the North Carolina coast. He fought desperately with sword and pistol until he fell with 25 wounds in his body. His head was taken back to Virginia and displayed on a pole.

Blackbeard was born Edward Teach, in either Bristol, England or in Jamaica. He is said to have had 14 wives. In 1997, researchers claimed to have found the remains of Blackbeard's ship *Queen Anne's Revenge* near the coast of North Carolina. Robert C. Ritchie

See also **South Carolina** (picture: Blackbeard).

Blackberry is a small round fruit that grows on a flowering shrub or a trailing vine. Blackberries may be black, dark red, or yellow. Each blackberry consists of a cluster of tiny fruits called *drupelets,* which grow around a core known as the *receptacle.* Blackberries are often confused with black raspberries. But the receptacles of blackberries, unlike those of black raspberries and other raspberries, are eaten with the rest of the fruit. Blackberries are eaten fresh or are processed for use in making jam, jelly, pies, preserves, and wine.

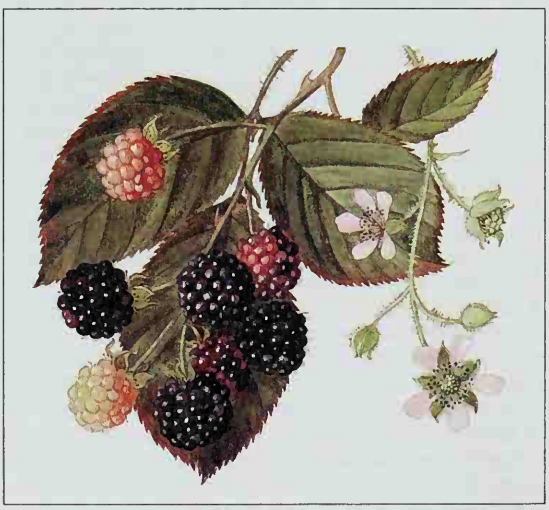
The United States is the leading producer of blackberries. The fruit grows wild in most Midwestern and Eastern states. Blackberries are also produced commercially in Arkansas, Michigan, Missouri, New York, Oklahoma, Oregon, Texas, Washington, and other states.

Growers produce blackberry plants by cutting 6-inch (15-centimeter) sections from blackberry roots and burying them in loose loam. The roots are placed in rows about 8 to 10 feet (2.4 to 3 meters) apart. Growers plant the root sections in early spring, and only fruitless stems develop during the first growing season. Fruit production starts the next year, reaching its peak in the fourth or fifth years. Most blackberry plants live 15 to 20 years.

Blackberries to be sold as fresh fruit are harvested by hand. Those to be sold for processing are harvested by machines that shake the fruit from the bush. More than 90 percent of the blackberries grown commercially in the United States are sold for processing.

Blackberry plants require special care to produce large crops of fruit. For example, growers prune the plants regularly. Growers also spray the plants with pesticides for protection against insects. Paul Eck

Scientific classification. The blackberry is a member of the rose family, Rosaceae. It is classified as genus *Rubus.* Wild blackberries are *R. alleghenienses.*



WORLD BOOK illustration by Kate Lloyd-Jones, Linden Artists Ltd.

The blackberry plant produces small black fruits that grow near the stalk. Blackberry blossoms have pink and white petals.

See also **Blight; Boysenberry; Bramble; Dewberry.**

Blackbird is the family name given to many kinds of small birds whose plumage, at least in the males, is black. There are many other black or blackish birds not in the blackbird family. The *yellow-headed* blackbird lives in the Western United States and southern portions of Canada. It nests in *colonies* (large groups) on reeds that overhang open water. Another blackbird, the *red-winged* blackbird, is found in most parts of North America. The male has shoulders tipped with bright red and yellow. The female has a dark brown back with black and gray streaks, and a streaked dusky-white breast.

Jen and Des Bartlett, Bruce Coleman Inc.

Red-winged blackbird

Red-winged blackbirds live in swamps or marshes, and make their nests in the rushes. In addition, sometimes they nest in low bushes on the edge of a pond, or in cattails or marsh grass. Their nests have also been found among the weeds and clover in hayfields.

Red-winged blackbirds' nests are made of grass, mud, and plant fibers. The birds lay from three to six eggs, colored light blue with black or purple spots. Red-wings are friendly birds. They gather in flocks in the fall and spring. The flocks sing their song over and over. It has been described as sounding like "konk-ka-reee."

Blackbirds are useful because they eat insects and weed seeds. But in some places, blackbirds also eat growing grain. Donald F. Bruning

Scientific classification. Blackbirds belong to the subfamily Icterinae of the emberizid family, Emberizidae. The red-winged blackbird is *Agelaius phoeniceus.*

See also **Bird** (picture: Birds' eggs); **Grackle.**

Blackboard. See Chalkboard.

Blackbuck is a graceful antelope that lives in India and Pakistan. The *doe* (female) and young male are *fawn*-colored (light yellowish-brown). Their bellies and the inner sides of their legs are white. As the male gets older, his fawn color turns to glossy black, except for white patches on the chin and around the eyes and a fawn patch on the back of the neck. The male stands about 32 inches (81 centimeters) high at the shoulder. The buck's spiral-shaped horns grow 18 to 28 inches (46 to 71 centimeters) long and are ringed almost to the tips. Blackbucks live in groups in semidesert to open woodland regions. They feed on grass and woody plants, and sometimes damage crops. They are fast runners.

William L. Franklin

Scientific classification. The blackbuck is a member of the bovid family, Bovidae. Its scientific name is *Antilope cervicapra.*

Blackdamp. See Damp.

Blackfeet Indians lived on the Great Plains of the United States and Canada. The three tribes in this group

were (1) the Blood, (2) the Piegan (pronounced *pay GAN*), and (3) the Siksika (pronounced *SIHK sih kah*). The Siksika lived chiefly in Canada. Before 1850, the Blackfeet claimed a broad area just east of the Rocky Mountains. This area extended southward from present-day Edmonton, Alberta, to Yellowstone National Park.

In the early days, the Blackfeet hunted buffalo on foot. Later, they became skilled at stealing horses. Warriors quietly entered enemy camps, cut loose the best horses, and led them away while their owners slept. The Blackfeet lived in buffalo-hide tepees. Some families owned sacred bundles of *fetishes,* which might include bones, skins, or stones (see **Fetish**). They opened the bundles on special occasions to cure the sick or to ensure the people's welfare.

During the early 1800's, American beaver trappers began to enter the Blackfeet hunting grounds. After the Indians had killed a number of whites, the Americans let the Blackfeet do the trapping and bring the furs and hides to the white trading posts. In exchange, the Indians received guns and ammunition, metal knives and tools, glass beads, and other articles. Some Blackfeet opposed the beaver trade because the beaver is sacred to the Blackfeet.

Today, the Blackfeet farm and raise livestock. They live on a reservation in Montana, and on three Canadian reserves. Those living in Canada usually use the name Blackfoot. Jamake Highwater

See also **Indian, American** (Indians of the Plains); **Crowfoot.**

Blackfish is the common name for several fishes, such as the Alaska blackfish and the tautog. The black sea bass is sometimes called a blackfish.

The *Alaska blackfish* lives in ponds and streams in Alaska and Siberia. It grows about 8 inches (20 centimeters) long. It is hardy and can survive below-freezing water temperatures for a short time. But if the internal body cells freeze, the cells rupture and the fish dies.

The *tautog* is a food fish that lives along the Atlantic Coast from New Brunswick, Canada, to South Carolina. It is about 2 feet (61 centimeters) long, and weighs about 10 pounds (4.5 kilograms).

Bruce Coleman Inc.

The black sea bass is a common type of blackfish.

The *black sea bass* is common along the Atlantic Coast of the United States. This fish has an unusual life cycle. Most of the young are females, but at about 5 years of age, the fish change sex and become males.

Scientific classification. The Alaska blackfish belongs to the mudminnow family, Umbridae. It is *Dallia pectoralis.* The tautog belongs to the wrasse family, Labridae. It is *Tautoga onitis.* The black sea bass belongs to the sea bass family, Serranidae. It is *Centropristes striatus.* Henry W. Robinson

Blackhead. See **Acne; Pore.**

Blackleg. See **Cattle** (Diseases).

Blacklist is a list of people or organizations believed to deserve suspicion, disapproval, and punishment. Individuals or groups on a blacklist may lose their jobs or business contacts or be denied financial credit and other services.

Blacklists were widely used during the late 1800's to curb the growth of labor unions. Employers exchanged lists of workers suspected of union membership to prevent such workers from finding jobs. The National Labor Relations Act of 1935 outlawed the use of blacklists aimed at discouraging union activity.

Some people have been blacklisted because they supposedly held unpopular political beliefs. In the early 1950's, for example, Senator Joseph R. McCarthy of Wisconsin accused a number of federal employees of being Communists. Many of these people lost their jobs, despite the fact that most charges were not supported by evidence. During this same period, many private firms, especially in the entertainment industry, blacklisted workers who supposedly were Communists.

Some countries use blacklists to discourage business firms or governments from dealing with an enemy nation. For instance, some Arab nations refuse to trade with any company that does a substantial amount of business with Israel. Thus, a company that continues to trade with Israel may lose millions of dollars of Arab business.

A number of credit bureaus put together blacklists of individuals or businesses they consider poor credit risks. In most cases, these people have failed to make regular payments on loans or other debts. The credit bureaus furnish the blacklists on request to banks and other lenders.

The United States Department of Labor uses blacklists to prevent job discrimination. Under the Equal Employ-

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Blackbucks roam the plains of India and Pakistan, feeding on grass. Male blackbucks, *above,* have long, spiral-shaped horns that they keep throughout their lives.

ment Opportunity Act of 1972, the department has the power to blacklist companies that refuse to cooperate in equal opportunity efforts.

Dora E. Polachek and Solomon W. Polachek

See also **Blockade; Boycott.**

Blackmail is a crime in which a person, using written or spoken threats of force or fright, demands money or property to which the person is not entitled. The most common method of blackmail is to threaten to expose the victim to the public by telling the public about certain past misdeeds, whether real or pretended. The threat can also be to the physical well-being of the victim or a member of the victim's family. Blackmail is punishable by imprisonment or fine, or both.

George T. Felkenes

See also **Extortion.**

Blackmun, Harry Andrew (1908-1999), served as an associate justice of the Supreme Court of the United States from 1970 to 1994. Blackmun had been appointed to the court by President Richard M. Nixon.

During his early years on the Supreme Court, Blackmun generally voted with the other three conservative justices appointed by Nixon. The group consisted of Blackmun, Warren E. Burger, Lewis F. Powell, Jr., and William H. Rehnquist. In 1973, however, Blackmun took a liberal position when he wrote the court's majority opinion in the case of *Roe v. Wade*. This decision essentially prohibited states from interfering with a woman's right to have an abortion during the first six months of pregnancy. Beginning in the late 1970's, Blackmun generally sided with the liberal justices William J. Brennan, Jr., and Thurgood Marshall.

Blackmun was born on Nov. 12, 1908, in Nashville, Illinois, but grew up in St. Paul, Minnesota, where he was a boyhood friend of Burger's. Blackmun graduated from Harvard University in 1929 and from Harvard Law School in 1932. After spending a year as a law clerk in St. Paul, he joined a Minneapolis law firm specializing in tax and probate law. In 1950, his interest in medical law led him to become general counsel for the Mayo Clinic in Rochester, Minnesota. Blackmun held that position until 1959, when he was appointed as a judge of the United States Court of Appeals for the Eighth Circuit, in Minnesota.

Blackmun was Nixon's third nominee to fill the U.S. Supreme Court seat left vacant by the resignation in 1969 of Justice Abe Fortas. The Senate rejected the president's first two nominees—United States Circuit Judge Clement F. Haynsworth, Jr., of South Carolina and Federal District Judge G. Harrold Carswell of Florida.

Owen M. Fiss

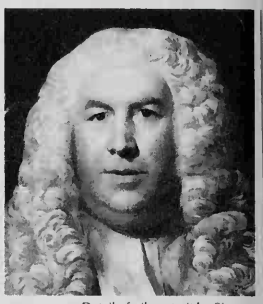
Blacks. See African Americans.

Blackstone, Sir William (1723-1780), an English judge, author, and professor, won recognition for his *Commentaries on the Laws of England* (1765-1769). This book presented a comprehensive picture of the English law of his time, and became the most influential book in the history of English law. It was the basis of legal education in England and America for years. Blackstone's book greatly influenced American colonists. The colonists used it as their chief source of information about English law.

Blackstone's temperament apparently was not suited to the practice of law, and, on the advice of a friend, he began to deliver lectures on English law at Oxford University. This was a novel undertaking. At that time English law was not considered an appropriate subject for instruction. Instead, Roman civil law, the law of continental Europe, was taught at Oxford.

His lectures were so successful that Charles Viner (1678-1756), author of an abridgment of English law, endowed a chair on the subject. Blackstone became the first professor of English law in 1758.

Blackstone also served as a member of Parliament. In one embarrassing incident in Parliament, Blackstone's own *Commentaries* were quoted in a debate to show that he was wrong in a matter of law. He became Judge of the Common Pleas in 1770. Later, Blackstone served as a judge on the King's Bench, but he soon returned to the Common Pleas. Later in his life, he advocated prison reform and obtained some legislation on it.



Detail of oil portrait by Sir Joshua Reynolds, National Portrait Gallery, London

Sir William Blackstone

Blackstone was born in London. He studied at Charterhouse School and Oxford University. He wanted to be an architect, a drama critic, and a poet. However, Blackstone felt he could not make enough money in these careers, so he began the study of law. Daniel J. Dykstra

Blacktail. See Mule deer.

Blacktop. See Asphalt.

Blackwell, Antoinette Brown (1825-1921), was the first ordained woman minister in the United States. She worked to promote civil rights for blacks and women's right to vote.

Blackwell was born in Henrietta, New York, near Rochester. She finished her religious studies at Oberlin College in 1850. However, the college did not permit her to graduate because it opposed women becoming ordained ministers. For the next three years, Blackwell lectured against slavery and in favor of women's rights and efforts to outlaw alcoholic beverages. She also preached at any church that accepted her.

In 1853, Blackwell was ordained a minister of a Congregational church in Wayne County, New York. Blackwell resigned in 1854 because she considered many of the church's doctrines to be too strict. Blackwell then joined a Unitarian church, where she occasionally preached.

Blackwell wrote *The Sexes Throughout Nature* (1875). In this book, she criticized the famous British scientist Charles R. Darwin, who had become known for his theory of evolution. Blackwell accused Darwin of using his theory to try to prove that women were inferior to men. Nancy Woloch

Historical Pictures Service

Antoinette Blackwell

Blackwell, Elizabeth (1821–1910), was the first woman in the United States to receive a medical degree. She helped break down prejudice against women in medicine. Blackwell graduated from medical school in 1849. In 1857, she and her younger sister Emily Blackwell, a surgeon, opened their own hospital in New York City. The hospital, called the New York Infirmary for Women and Children, was staffed entirely by women and primarily served the poor. The sisters later expanded the hospital to include a medical school for women.

Blackwell was born in Bristol, England, and came to New York with her family at the age of 11. In 1847, she began her medical studies at Geneva College in Geneva, New York, after 29 other medical schools had denied her admission because of her sex. Following her graduation, she traveled to Europe for practical training in hospitals there. When she returned to New York in 1851, she encountered much prejudice as a woman physician. Few patients came to see her, and hospitals barred her from their wards. Male doctors ignored her. Eventually, however, Blackwell earned the respect of the medical community and of the public. She returned to England in 1869, where she spent the rest of her life working to open the medical profession to women.

Blackwell wrote several books and lectured widely. She helped introduce the belief that sanitation and personal hygiene played major roles in the prevention of disease. In 1949, the American Medical Women's Association established the Elizabeth Blackwell Medal to honor her achievements. The medal is awarded each year to the woman physician who has made the most outstanding contribution to the cause of women in the field of medicine. Miriam Schneir

Additional resources

Burby, Liza N. *Elizabeth Blackwell: The First Woman Doctor.* PowerKids Pr., 1997. Younger readers.

Kline, Nancy. *Elizabeth Blackwell: A Doctor's Triumph.* Conari Pr., 1997.

Ross, Ishbel. *Child of Destiny: The Life Story of the First Woman Doctor.* Harper, 1949.

Schleichert, Elizabeth. *The Life of Elizabeth Blackwell.* 21st Century Bks., 1992. Younger readers.

Blackwood, Frederick Temple. See Dufferin and Ava, Marquess of.

Bladder is the common name for the urinary bladder, a hollow muscular organ that stores urine before expelling it from the body. The emptying of the urinary bladder is voluntarily controlled in most human beings and many other mammals.

The bladder lies just behind the *pubis,* one of the bones of the pelvis. Urine drains continuously from the kidneys into the bladder through two tubes called *ureters.* It leaves the bladder through the *urethra,* a wider tube that leads out of the body. The place where the bladder and the urethra meet is called the *neck* of the bladder. A complex arrangement of muscles encircles the bladder neck. This ring, called the *urethral sphincter,* normally prevents urine from leaving the bladder.

The bladder can hold more than a pint (0.5 liter) of urine. As the bladder fills, its muscular wall relaxes and its lining stretches, allowing it to expand. The bladder begins to send signals to the brain that cause the desire to urinate. For urination to occur, the urethral sphincter must relax. The muscles of the bladder wall then contract, forcing urine out through the urethra.

The inability to control urination is called *incontinence.* In adults, incontinence may result from muscle weakness due to aging or from a variety of other causes. These include injury to the sphincter during surgery, damage to the bladder nerves, or a stroke affecting the brain's regulation of urination.

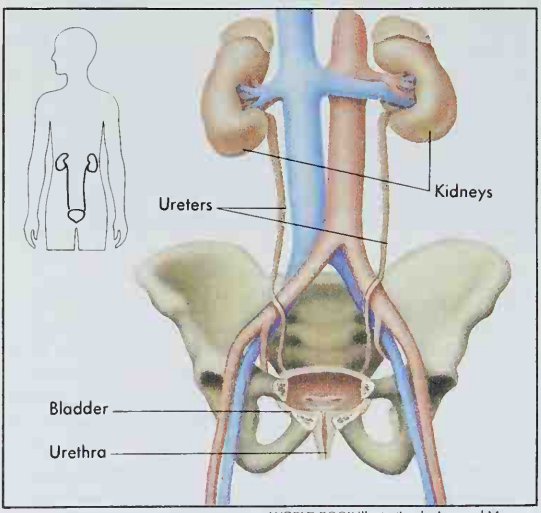
Common diseases of the bladder include bladder inflammation, called *cystitis,* and cancer. Most cases of cystitis result from bacterial infection and can be cured with medication. If left untreated, the infection may spread to the kidneys. Cancerous tumors must be removed surgically. A physician uses an instrument called a *cystoscope* to look inside the bladder and to remove small tumors. A cystoscope is inserted through the urethra. Larger tumors may require removal of most or all of the bladder. The urine is rechanneled through an artificial opening in the abdomen and is collected in a plastic pouch worn by the patient. Earl F. Wendel

See also **DMSO; Incontinence; Kidney; Prostate gland; Urine.**

Bladderwort, *BLAD uhr WURT,* is the name of a group of water or marsh plants that grow throughout the world. About a dozen kinds live in North America. Most bladderworts grow underwater. Some species found in wet, tropical areas are able to grow on land. Bladderworts have hundreds of little flask-shaped bladders on their stems and leaves. The plants have weak stems and no roots. The yellow or purplish flowers stand just above the water's surface.

Bladderworts are called *carnivorous plants* because their bladders trap small insects and larvae. The bladders are about $\frac{1}{8}$ inch (3 millimeters) long. Each has a mouth closed by a trap door that opens only inward. When an insect touches the sensitive hairs around the mouth, the bladder's sidewalls spring outward. This creates a sucking action and pulls the insect into the bladder. Then the plant digests the animal. David A. Francko

Scientific classification. Bladderworts are in the bladder-



WORLD BOOK illustration by Leonard Morgan

The urinary bladder stores urine that drains continuously from the kidneys. Urine enters the bladder through slender tubes called *ureters.* It leaves through the *urethra,* a wider tube.

Kim Taylor, Bruce Coleman Ltd.

A bladderwort plant captures a mosquito.

wort family, Lentibulariaceae. Bladderworts make up the genus Utricularia.

Blaine, James Gillespie (1830-1893), was an important American political leader for many years. He was called the *Plumed Knight* by American lawyer Robert G. Ingersoll, who supported him for president of the United States in 1876. Blaine sought the Republican nomination for president that year but lost to Rutherford B. Hayes.

Blaine was born in West Brownsville, Pennsylvania, and graduated from Washington College in Pennsylvania. He settled in Maine in 1854 and became part owner of the Kennebec *Journal*. He was later an editor of the Portland *Advertiser*. An early supporter of the new Republican Party, Blaine was elected to Maine's legislature in 1858.

Four years later, Blaine was elected to the U.S. House of Representatives. He served as speaker of the House from 1869 to 1875. In 1876, charges that he had used his position as speaker for personal gain helped ruin Blaine's campaign for the presidency. That same year, however, he was elected to the U.S. Senate. In 1880, Blaine again sought the Republican nomination for president but lost to James A. Garfield. Blaine served nine months as Garfield's secretary of state.

Blaine finally received the Republican presidential nomination in 1884 but lost the election to Democratic nominee Grover Cleveland. Once again, charges of political dishonesty hurt Blaine in his attempt to become president. Blaine served as secretary of state in President Benjamin Harrison's Cabinet from 1889 to 1892. As secretary, Blaine concluded a treaty with Germany concerning the Samoa Islands and promoted U.S. leadership in the Western Hemisphere in the first Pan American Conference. In 1892, Blaine again sought the Republican presidential nomination but lost. Robert W. Cherny

See also **Cleveland, Grover** (Election of 1884).

Blair, Bonnie (1964-), an American speed skater, won five gold medals and one bronze in the Winter Olympic Games, more than any other American athlete. Blair was the first American woman in any sport to win a gold medal in consecutive Winter Olympics. She was also the first American long track speed skater to win a gold medal in more than one Olympic competition.

Blair won her first Olympic medal in 1988. She won the 500-meter race and received a bronze medal for third place in the 1,000-meter race at the games in Calgary, Canada. She won the gold medal in both races at the 1992 Winter Olympics in Albertville, France. At the 1994 games in Lillehammer, Norway, she again won both races and narrowly missed winning a bronze by finishing fourth in the 1,500-meter race.

Blair was born in Cornwall, New York. She began skating while growing up in Champaign, Illinois.

Sean Callahan

Blair, Eric. See Orwell, George.

Blair, Francis Preston, Jr. (1821-1875), was an important political leader in Missouri. He served in both the United States House of Representatives and the United States Senate. In 1868, he was the unsuccessful Democratic Party candidate for vice president of the United States.

Blair was born in Lexington, Kentucky. He became a lawyer and practiced law in St. Louis, Missouri. Beginning in the 1840's, Blair became a newspaper writer, editor, and owner in St. Louis. Through several newspapers, he opposed the expansion of slavery. From 1852 to 1856, Blair served in the Missouri legislature.

During the 1850's, Blair joined the new Republican Party. He served in the U.S. House of Representatives during most of the period from 1857 to 1864. During the American Civil War (1861-1865), Blair helped keep Missouri from joining the Confederacy. He fought for the Union Army at Vicksburg and in other battles.

After the war, Blair felt the Republican-controlled Congress's treatment of the Southern States was too harsh. As a result, he joined the Democratic Party. From 1871 to 1873, Blair served in the U.S. Senate. A statue of him represents Missouri in the U.S. Capitol.

Michael Perman

Blair, John (1732-1800), a Virginia lawyer and judge, was a signer of the Constitution of the United States. He seldom spoke at the Constitutional Convention in 1787. But Blair often cast the deciding vote when the other Virginia delegates were evenly split. On the issue of a strong national government, he sided in its favor. In 1789, President George Washington appointed him an associate justice on the first Supreme Court of the United States. Blair held that position until 1796.

Blair was born in Williamsburg, Virginia. He attended the College of William and Mary and studied law in London. Blair served in the Virginia House of Burgesses from 1766 to 1770. In 1776, Blair was on the committee that drafted Virginia's first constitution. From 1778 to 1789, Blair served as a judge in four different Virginia courts. Joan R. Gundersen

Blair, Tony (1953-), became prime minister of the United Kingdom in 1997 and retained the post in 2001. The Labour Party, led by Blair, won election both years by large margins. Blair's first-term government helped bring a peace settlement to Northern Ireland and set up new parliaments in Northern Ireland, Scotland, and Wales. Blair also played a significant role in European politics and forged close ties to other world leaders.

Blair has been the Labour Party leader since 1994. He was instrumental in transforming the party. He supported efforts to reduce the influence of labor unions on party policies. In 1995, party members voted to drop from the party's constitution a statement of socialist principles.

AP/Wide World

Tony Blair

On Sept. 11, 2001, many British citizens and thousands of others died in terrorist attacks in the United States. In response, the United States, the United Kingdom, and other countries launched a campaign against terrorism that included extensive military operations in Afghanistan. Blair took a leading role in building international support for the campaign.

Anthony Charles Lynton Blair was born in Edinburgh. He was educated at Oxford University, and he became a lawyer in 1976. He was elected to the House of Commons in 1983. When Labour Party leader John Smith died in 1994, Blair was elected to succeed him.

Keith Robbins

Blair House. See Washington, D.C. (White House).

Blake, William (1757-1827), was a brilliant and unconventional English poet, engraver, and painter. His symbolic pictures and visionary poems are not always easy to understand because Blake developed an elaborate personal mythology that underlies virtually all the symbolism and ideas in his works. Blake's writings and pictures reveal how a powerful artistic imagination can mold the world in its own image.

Blake thought that we have war, injustice, and unhappiness because our way of life is founded on mistaken beliefs. We cannot truly know reality through our five senses, yet we concern ourselves almost entirely with scientific truth and materialistic values gained through those very senses. We cannot understand the vast reality beyond the material and achieve full control of ourselves until we learn to trust our instincts, energies, and imaginations. For Blake, this belief was the basis for all personal, social, and religious truth.

Blake was born in London and lived most of his life there. He was a book illustrator and engraver by profession. He claimed to have seen visions, beginning in his childhood, and he called many of his poems either visions or prophecies.

Blake has received much praise for such pictures as his illustrations for the *Book of Job,* but he was most interested in his "illuminated printing." This was a process of engraving poems and related pictures on metal plates and then hand-coloring the prints made from them. Except for *Poetical Sketches* (1783), most of Blake's published poetry appeared in this unique form.

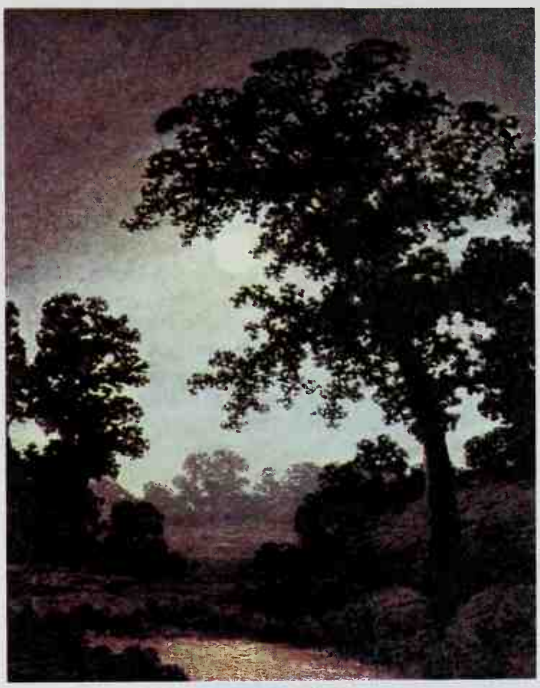
Blake is best known for *Songs of Innocence* (1789) and *Songs of Experience* (1794). In these works, he shows, in such contrasting poems as "The Lamb" and "The Tyger," symbols of what he calls "the two contrary states of the human soul."

Frederick W. Shilstone

Blakelock, Ralph Albert (1847-1919), was an American landscape painter. Many of his works feature wild, lonely scenes with trees silhouetted against the moon or the setting sun. Blakelock simplified the appearance of most of his subjects to create a mystical or romantic mood. He used rich, mellow colors. Many of his paintings were inspired by music.

Blakelock was born in New York City, and he lived there most of his life. From 1869 to 1872, he wandered through the West. Blakelock based much of his later work on his memories and sketches of the West. In 1899, Blakelock suffered a mental breakdown, largely because of artistic rejection and financial pressure. He never recovered.

Sarah Burns



The Poetry of Moonlight (about 1890), an oil painting on canvas; the Heckscher Museum, Huntington, New York, August Heckscher Collection

A typical Blakelock landscape shows a wilderness scene at night. The painter created a romantic mood by silhouetting tree leaves and branches against the sky glowing with moonlight.

Blanc, Mont. See Mont Blanc.

Blanchard, Jean-Pierre (1753-1809), a French aviation pioneer, made the first balloon flight across the English Channel in 1785 with John Jeffries, an American physician. He also made the first balloon voyage in the United States in 1793. Blanchard had proposed heavier-than-air machines in 1781. But as soon as the Montgolfiers and Pilâtre de Rozier made successful balloon

flights, Blanchard became an ardent balloonist. He made 60 ascents, a record that stood for about 50 years. He was born in Les Audelys, France. Richard P. Hallion

Blanching. See **Cooking** (table: Terms used in cooking); **Food, Frozen** (Freezing food at home).

Bland, James A. (1854-1911), was a black American composer. In 1878, he published "Carry Me Back to Old Virginny." This song, with the name changed to "Carry Me Back to Old Virginia," was the state song of Virginia from 1940 to 1997. Bland's other well-known songs include "In the Evening by the Moonlight" and "Oh, Dem Golden Slippers." He also became popular as a banjo player and starred in a black minstrel company. He was born in Flushing, New York. Gerald Bordman

Blank verse is poetry written in unrhymed lines of iambic pentameter. For a discussion of iambic pentameter, see **Poetry** (Foot-verse meters). This example of blank verse is from William Shakespeare's tragedy *Julius Caesar:*

> His life was gentle, and the elements
> So mixed in him that Nature might stand up
> And say to all the world, "This was a man!"

Blank verse is not written in stanza form. Instead, the poem is developed in *verse paragraphs* that vary in length. Blank verse is a flexible form of expression that gives the poet a choice of many variations within the metrical pattern. Because of its flexibility, blank verse is especially appropriate for narrative and dramatic poetry and other longer kinds of poetry. Blank verse is sometimes confused with free verse. But free verse, unlike blank verse, has no definite meter.

Henry Howard, Earl of Surrey, adapted blank verse from Italian poetry to English in the early 1500's. Christopher Marlowe and Shakespeare used this form with great power and variety in their plays. Many poets of the 1800's and 1900's wrote in blank verse. They include William Wordsworth, William Cullen Bryant, John Keats, Lord Tennyson, Edwin Arlington Robinson, Robert Frost, and Wallace Stevens. Paul B. Diehl

Blarney Stone is a block of limestone in Blarney Castle, near Cork, Ireland. According to legend, anyone who kisses the stone receives the gift of expressive, convincing speech. The stone was set in a tower of the castle in 1446. The legend may have begun after an old woman cast a spell to reward a king who had saved her from drowning. If the king kissed the stone while under the spell, he would gain the ability to speak sweetly and convincingly. Today, the word *blarney* means clever, flattering, or coaxing talk. Christopher McIntosh

R. Pastner, FPG

Preparing to kiss the Blarney Stone, a woman lies on her back. She will bend backward to kiss the stone—the slab below the top of her head. A Blarney Castle employee assists her.

Blasco Ibáñez, Vicente, *BLAH skoh ee BAH nyehth, vee THEHN teh* (1867-1928), was a Spanish novelist. He was born in Valencia, and his best novels realistically portray rural life in the Valencian region. They also feature vivid descriptions of nature. These works include *The Mayflower* (1895), *The Cabin* (1898), *In the Orange Groves* (1900), and *Reeds and Mud* (1902).

Blasco Ibáñez's best-known novels are *Blood and Sand* (1908), a melodramatic story based on bullfighting, and *The Four Horsemen of the Apocalypse* (1916), a vigorous antiwar story. The latter book made him the most famous Spanish writer of his time outside of Spain. However, most critics consider them inferior to his novels about the Valencian region.

Blasco Ibáñez published two newspapers that attacked what he regarded as the injustices of the Spanish monarchy. He served six terms in the Spanish parliament and formed a political party that worked for social reform. Blasco Ibáñez was jailed about 30 times because of his political opinions, and he went into exile several times during his life. David Thatcher Gies

Blatch, Harriot Eaton Stanton (1856-1940), was a leader of the American woman suffrage movement. This movement worked to get women the right to vote. In the early 1900's, Blatch organized several suffrage parades and women's meetings in New York. These events helped create public support for the suffrage movement, and in 1917, the state gave women the right to vote.

In 1907, Blatch formed the Equality League of Self-Supporting Women, the first American suffrage group that included working-class women. The league held the nation's first suffrage parades and open-air meetings. Blatch later joined the National Woman's Party during its campaign for an equal rights amendment to the United States Constitution.

Brown Brothers

Harriot Stanton Blatch

Blatch was born in Seneca Falls, New York. Her father, Henry B. Stanton, was a prominent abolitionist, and her mother, Elizabeth Cady Stanton, was one of the earliest leaders of the women's rights movement. Blatch graduated from Vassar College and later earned a master's degree there. She wrote two books, *Mobilizing Woman Power* (1918) and *A Woman's Point of View* (1920). June Sochen

Blazing star is the name of a group of wildflowers. They grow mainly on prairies and meadows in the eastern and midwestern United States. People sometimes call these flowers *button snakeroot* or *gayfeather.*

The blazing star is a tall, slender plant from 1 to 6 feet

(30 to 180 centimeters) high. Thick clusters, or *heads,* of small purple or rose-red blossoms grow along the stem on thin spikes up to 18 inches (46 centimeters) long. The heads are surrounded by *bracts,* or modified leaves, the same color as the flowers. These *spikes,* or wands, of blossoms resemble a shooting star, for which the flower is named. The name *blazing star* has also been given to asters, goldenrods, and several thistles.

Scientific classification. Blazing stars make up the genus *Liatris* in the composite family, Asteraceae or Compositae.

David J. Keil

See also **Flower** (picture: Flowers of prairies and dry plains).

Bleach is any substance that lightens, brightens, or removes the color from a material. Manufacturers bleach textiles, paper, and other materials to whiten them or to prepare them to be dyed. Homemakers use laundry bleach to brighten clothes. People also use some bleaches as disinfectants. There are two main kinds of bleaches, *chemical* and *optical.*

Chemical bleaches act on the colored molecules that give a material its color. The bleaches make these molecules colorless or nearly colorless. The most widely used chemical bleaches include chlorine bleaches and oxygen bleaches. Many household and industrial bleaches are chlorine bleaches, which remove the color from most textiles, wood pulp, pottery, and other materials. Oxygen bleaches are milder than chlorine ones. People use hydrogen peroxide and other oxygen bleaches to lighten hair and to brighten colored fabrics and other materials that might be harmed by chlorine bleaches (see **Hydrogen peroxide**).

Other chemical bleaches include certain sulfur compounds. These compounds are used to bleach some wools, silks, and various types of manufactured fibers.

Optical bleaches mask yellow discoloration in a material. These bleaches, commonly called *fabric brighteners,* absorb ultraviolet light and change it to blue light. The combination of the blue light and the yellow discoloration produces white light that makes the material seem brighter (see **Color** [Mixing colored lights]). Several laundry detergents contain optical bleaches to mask discolorations that are hard to remove.

Many ancient peoples bleached textiles. They treated the cloth with smoke from burning sulfur or with bleaches they made from various plants or plant ashes. Then they spread the treated cloth on the ground to whiten in the sun. Similar bleaching methods were used until the 1700's, when manufactured bleaches were developed. Today, textile factories use a variety of methods, depending on the kind of cloth. In most cases, the cloth is washed, soaked in a bleaching solution, then soaked in various chemicals to reduce any harmful effects from the bleach. Finally, the cloth is rewashed, thoroughly rinsed, and dried. Howard L. Needles

Bleeding is the escape of blood from blood vessels. It takes place when there is a break in arteries, veins, or *capillaries* (tiny blood vessels). Breaks may be caused by injury or by tissue damage resulting from cancer, an ulcer, or infections.

Kinds of bleeding. Blood from an artery spurts from a wound due to the great pressure it is under. Bleeding from a vein, where there is less pressure, flows steadily. Blood from capillaries leaks out slowly.

Bleeding may be *external,* on the outside of the body, or *internal,* on the inside. When the skin breaks and bleeds it is called a *laceration.* In an injury that does not break the skin, blood seeps from injured blood vessels into the surrounding flesh, forming a bruise. Internal bleeding is caused by disease or injury and may occur slowly or rapidly. Severe bleeding is called a *hemorrhage,* and may occur internally or externally.

Effects of bleeding. Minor bleeding from cuts or bruises normally does not cause a problem. However, when a loss of blood occurs that is greater than the amount of new blood produced by the bone marrow, a weakened condition called *anemia* develops. Bleeding within the skull produces pressure on the brain that can injure brain tissue, sometimes resulting in loss of brain function. In some circumstances, bleeding into other internal organs may cause organ damage or failure.

The sudden loss of a large quantity of blood causes a drop in blood pressure, resulting in a dangerous condition called *shock.* Shock may be the only apparent symptom of internal hemorrhaging. Too great a loss of blood will result in death.

How bleeding is stopped. Bleeding is usually controlled by the formation of a clot within a broken blood vessel. The clot seals the vessel and prevents the flow of blood. A clot on the skin surface is a scab. *Coagulation,* the blood-clotting process, is one of the body's vital protective functions. Some people have blood that does not clot normally. These individuals tend to bleed heavily from even a slight injury. Hemophilia, a hereditary disease, is one of several conditions in which excessive bleeding occurs.

First aid for bleeding. First aid for bleeding consists of applying pressure on the wound. Pressure applied by a sterile gauze bandage held firmly on the wound usually stops the flow of blood. Small vessels near the surface of the skin may be compressed on the side of the wound from which the blood is flowing.

If direct pressure fails to stop the bleeding, it may be necessary to press on the artery above the bleeding point. Places where an artery lies over a bone and may be easily compressed are called *pressure points.* The two most common ones are in the upper arm and at the top of the thigh where it meets the abdomen. Both direct pressure on the wound and pressure to an artery should be maintained until medical help arrives.

Nosebleed may be stopped by pressing the nostrils together, or by applying cold, wet compresses to the nose. If these methods are not effective, a physician should be called. Joseph V. Simone

Critically reviewed by the American Red Cross

Related articles in ***World Book*** include:

Anemia	First aid (First aid for bleeding)	Hemorrhage
Blood (Controlling bleeding)	Hemophilia	Nosebleed
Bruise		Shock

Bleeding heart is a plant that bears heart-shaped rosy-red, pink, or white flowers in the late spring. It has delicate stems and blossoms. The long center stem arches. Gardeners brought the flower from Japan about 1850. It now grows in England, Australia, and the United States. The bleeding heart is a favorite garden flower. It is easy to grow. It can be kept indoors if it is taken out of the ground in the late fall. The plant is a perennial, and

Barry L. Runk from Grant Heilman

The bleeding heart has heart-shaped blossoms.

will grow from year to year. Indoors, it should be kept in warm rooms that have some moisture.

Robert A. Kennedy

Scientific classification. The bleeding heart belongs to the fumitory family, Fumariaceae. Its scientific name is *Dicentra spectabilis.*

Blenheim, *BLEHN uhm,* **Battle of,** was fought on Aug. 13, 1704. It was a turning point in the War of the Spanish Succession, and one of the decisive battles of European history. Allied French and Bavarian armies led by Marshal Tallard and Max Emanuel of Bavaria threatened to take Vienna. The Duke of Marlborough marched English troops to join Austrian forces under Prince Eugene of Savoy. Together, they badly defeated the French and Bavarians between the Bavarian villages of Blindheim (called *Blenheim* by the English) and Höchstädt on the Danube. The victory saved Vienna and cleared Germany of French troops. The battle is also called the Battle of Höchstädt. Robert G. L. Waite

Blériot, *BLAY RYOH,* **Louis,** *lwee* (1872-1936), a French aviation pioneer, made the first airplane flight across the English Channel on July 25, 1909. He flew in the 11th airplane that he had designed and built himself. He made the flight under bad conditions in order to win a prize being offered by the London *Daily Mail.* Blériot was ill from an abscessed foot when he finally took off after two unsuccessful attempts. The airplane engines at that time were unreliable and overheated rapidly. Typically, an engine began to run roughly after about 20 minutes. Blériot fortunately encountered a light, cooling rain that kept his engine running smoothly during his 37-minute flight. See **Airplane** (Other pioneer planes and fliers; picture).

Blériot was born in Cambrai, France. He did not become interested in aeronautics until he was 30 years old and had made a fortune manufacturing automobile headlamps. In 1907, Blériot built his third airplane, and it became one of the first successful monoplanes. He built an airplane in 1908 with a control system for the pilot that has never basically changed. Blériot's airplane did not have controls on the wings. It was turned by elevators at the tail which were in two pieces and moved separately. He later used *ailerons,* or hinged sections on the wings, to keep them steady. Blériot experimented in aircraft building and flying almost to the time of his death.

Richard P. Hallion

Bligh, *bly,* **William** (1754–1817), a British sea captain and colonial governor, won fame as a result of the mutiny on his ship, the *Bounty.* The mutiny occurred in 1789 near the island of Tofoa (now part of Tonga) in the South Pacific Ocean. Bligh and 18 of his crew were set adrift in a 23-foot (7-meter) boat with little food or water. They suffered incredible hardships, but sailed 3,900 miles (6,300 kilometers) across the Pacific to the Dutch colony of Timor in Southeast Asia. The mutineers on the *Bounty* sailed to Tahiti. Nine of them, led by Fletcher Christian, settled on Pitcairn Island (see **Pitcairn Island**).

Bligh resumed his career in the British navy in 1791. In 1806, he became governor of New South Wales, Australia. The next year, the English government asked him to end the liquor trade in New South Wales. Bligh's actions caused a rebellion in 1808, and Bligh was replaced as governor in 1810. He was promoted to rear admiral in 1811 and vice admiral in 1814.

Bligh was sailing master on Captain James Cook's third voyage around the world, from 1776 to 1779. Bligh was born in Plymouth, England. Gavin Kennedy

Blight is a condition of diseased plants in which whole parts of the plant die and wilt but do not rot or fall off. The parts affected may be leaves, flowers, fruits, or even entire stems. The term *blight* is also used for a variety of diseases that involve these symptoms. Most blights are caused by fungi. However, *fire blight,* which attacks pear and apple trees, is caused by bacteria. Blights often are named for the particular plant part attacked. For example, *blossom blight* attacks the blossoms of cherry trees.

Blights can be very destructive. During the 1840's, a potato blight in Ireland, where people were heavily dependent on potatoes for food, caused the crop to fail. About a million people died from starvation or disease during the famine. Blight can be avoided by using plants that have been specially bred to be resistant to disease. Spraying plants and disinfecting the seeds before planting can help prevent blight. As soon as a gardener notices diseased parts of a plant, those parts should be cut away and burned. David H. Wagner

Blimp is a small airship. Its gas bag has no metal framework and collapses when the gas is taken out. The British called these airships *limps* during World War I (1914-1918). Because the most common limp was type-B, the two names were soon combined into *blimp.* See also **Airship** (Nonrigid airships; picture: The uses of airships).

Blind spot is a small area of blindness that is present in the field of vision of the normal eye. The *field of vision* refers to everything that people see straight ahead and to the sides as they look steadily at any object.

Doctors can test the field of vision by seating a person 3 feet (91 centimeters) from a wall covered with black cloth. A small white object is then placed on the cloth directly in front of one eye. The other eye is covered with a patch. The person looks steadily at the object as a white-headed pin passes back and forth. If the right eye is being tested, the pin will disappear about

10 inches (25 centimeters) to the right of the white object. This area marks the blind spot.

The blind spot corresponds to the place at which the optic nerve enters the eyeball. There is no vision in this area because there is no *retina* (inner layer of the eyeball) there. Changes in size and shape of the blind spots give vital information in diseases such as glaucoma and brain tumor. Ronald Klein

See also Eye (The retina).

Blindfish. See Cavefish.

Blindness is the total or partial inability to see. It can be described in various ways. People who are *totally blind* cannot tell light from dark. Those who are *partially blind* have some sight that may be useful for certain purposes. People born unable to see are *congenitally blind.* Others lose their sight because of disease or injury and become victims of *acquired blindness.*

Blindness can also be described according to how it affects a person's life. A man or woman who is *economically blind* cannot see well enough to have a job that requires sight. People are *vocationally blind* if the loss of sight prevents them from continuing to work at their present job. A person who is *educationally blind* cannot see well enough to be educated without special materials or methods.

In the United States, a *legally blind* person is one who has *visual acuity* (sharpness of vision) of 20/200 or worse with glasses or contact lenses. A person with 20/200 vision sees from a distance of 20 feet (6 meters) what someone with normal vision—20/20 vision—sees from 200 feet (61 meters). People are also legally blind if they have an extremely limited *field of vision.* A person's field of vision is what is seen—straight ahead and all around—when looking steadily at an object. About 500,000 people in the United States are legally blind. Almost half of them are 65 years old or older.

Other conditions of blindness involve the inability to see under special circumstances or to tell colors apart. People with *night blindness* cannot see normally in reduced light, though they have normal vision in good light. Night blindness may be caused by various eye diseases or by a lack of vitamin A in the diet. *Snow blindness* is the temporary loss of vision due to bright sunlight reflected by snow. *Color blindness,* an inherited condition, is the inability to tell certain colors apart.

Causes of blindness

Diseases cause about 95 per cent of all blindness, and injuries cause the rest. A disease or injury can affect one or both of the eyes, the visual center of the brain, or the nerves that connect the eyes and the brain.

Diseases. Many diseases can cause blindness. The chief causes in the United States are cataract, diabetic retinopathy, glaucoma, and macular degeneration. This section also discusses the other major causes of blindness throughout the world.

Cataract is the clouding of the lens of the eye. Blindness results if the lens becomes *opaque* (nontransparent). The most common form of this disease, *senile cataract,* appears gradually as a result of aging. However, some babies are born with cataracts. Cataracts can be removed by surgery. After the operation, the patient wears strong glasses or contact lenses, or artificial lenses that are permanently placed in the eyes. In most cases, cataract surgery can restore useful vision.

Diabetic retinopathy occurs in some people who have diabetes mellitus over a period of years. Diabetes causes changes in the blood vessels of the *retina,* the part of the eye that absorbs light rays. In some cases, these blood vessels may burst and cause an *intraocular hemorrhage* (bleeding in the eye) that may cloud a person's vision. In other cases, fluid leaks from capillaries in the retina and causes the retina to thicken. Occasionally, the retina becomes detached from the back of the eye. Retinal detachment or bleeding into the *vitreous humor,* the clear fluid that fills the center of the eye, can cause blindness. Surgery can usually correct an intraocular hemorrhage or a detached retina. Early treatment with a laser can usually prevent these two problems. Laser treatment can also eliminate excess fluid in the retina and prevent a gradual loss of vision.

Glaucoma is a disease in which the fluid in the eyeball does not drain properly. Pressure builds up in the eye and may damage the *optic nerve,* which connects the eye with the sight center in the brain. The most common type of glaucoma occurs in people more than 40 years old. The field of vision gradually narrows, and total blindness may result. Another type of glaucoma occurs in some babies at birth. Most glaucoma cases can be treated with drugs or surgery.

Macular degeneration causes people to lose their ability to see things at the center of the field of vision. This loss of vision most often occurs as people age. Macular degeneration causes hemorrhaging, or cuts off the circulation of blood, in the *macula,* the center of the retina. The person loses central vision but retains *peripheral* (side) vision. People who have this condition may become legally blind. In its early stages, macular degeneration can be successfully treated with a laser.

Amblyopia is a condition that may occur if one eye is much stronger than the other, or if the two eyes are not lined up together. The most common form of amblyopia

Illinois Visually Handicapped Institute (WORLD BOOK photo by Cameramann International, Ltd.)

In a cooking class for the blind, students learn to make their own meals. A teacher, *right,* helps a blind man use the proper kitchen utensils to safely prepare food on a stove.

appears in children. If a child has better vision in one eye than in the other, he or she may begin to lose vision in the weaker eye. Physicians treat many cases of amblyopia by putting a patch over the strong eye in order to strengthen the weak one. If the condition is not corrected, the weak eye may become blind.

Corneal opacity may occur if the *cornea,* the clear tissue that covers the colored part of the eye, becomes scarred. Certain infections or injuries can cause such scarring. The cornea may also become opaque as a result of age. Corneal damage can cause blurred vision or blindness. In most cases of corneal infection, medication can prevent permanent damage to vision. Even if the cornea becomes permanently opaque, a surgeon may be able to perform a *corneal transplantation.* In this operation, the cornea is replaced with that of a person who recently died. Physicians obtain unscarred corneas from an agency called an *eye bank* (see **Eye bank**).

Ophthalmia neonatorum is an eye infection that strikes newborn babies. It is caused by bacteria that pass from the mother's birth canal into the infant's eyes. These bacteria include the ones that cause gonorrhea, a sexually transmitted disease. The symptoms of ophthalmia neonatorum—inflammation of the eyelids and cornea—appear two or three days after birth in most cases. The infection can produce blindness if it is not treated. In many countries, doctors prevent ophthalmia neonatorum by dropping a silver nitrate solution or an antibiotic ointment into the eyes of newborn babies. This procedure is required by most U.S. states.

Retinitis pigmentosa destroys the retina over a period of years. Night blindness is one of the first symptoms of this disease, and clumps of *pigment* (color) appears in the retina. The field of vision gradually narrows, and many victims become totally blind. The disease is hereditary. There is no treatment.

Retinoblastoma is cancer of the retina. It is usually hereditary. In most cases, a tumor forms on the retina during early childhood. X-ray treatment, drugs, or surgery may prevent the cancer from spreading. But if treatment fails, the eye must be removed.

Sympathetic ophthalmia is an unusual condition that occurs after one eye has been badly injured. The other eye may lose its sight even though it has not been damaged. In some cases, the injured eye must be removed to prevent blindness in both eyes. Physicians do not know the causes of sympathetic ophthalmia.

Trachoma is caused by a virus that affects the cornea and the *conjunctiva,* the lining of the eyelid. Unlike most eye diseases, trachoma is contagious. It is spread by some kinds of flies and by contact with towels and other articles used by people who have the disease. Physicians can cure most cases in their early stages, but blindness results in many advanced cases. Trachoma is a leading cause of blindness in India, the Middle East, and other developing regions. It rarely occurs in the United States or other countries that have good sanitation.

Injuries. Many kinds of injuries can cause blindness. Any particle that enters the eye may carry germs that can produce an infection leading to blindness. Certain chemicals can burn the eye. A blow to the head may damage the sight center of the brain and result in total blindness. Eye or head injuries can cause retinal detachment or bleeding into the vitreous humor. A wound that damages the optic nerve can also cause blindness.

Safety regulations help prevent industrial accidents that could cost workers their sight. In a number of industries, employees who have certain jobs are required to wear protective glasses. Many steelworkers wear them to prevent injury from flying metal fragments. Welders wear masks with special lenses to protect their eyes from the harmful light of the welding process.

Many hobbyists face the risk of eye injury when working at home. They also should use protective eyewear.

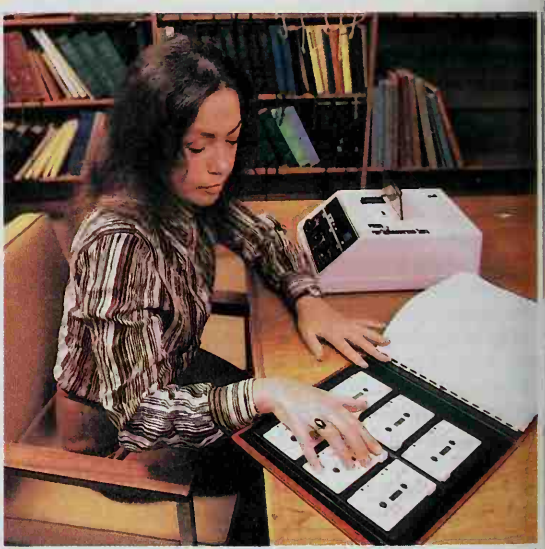
Overcoming blindness

Many schools and agencies provide education and training for people who are born blind or become blind later in life. These people learn special ways to read and to get around alone, and they are employed in a number of fields. Blind men and women hold jobs as computer programmers, electrical engineers, factory workers, lawyers, musicians, social workers, teachers, and X-ray technicians, and as many other kinds of specialists.

Aids for blind people include braille and *talking books* (recordings on records or tapes), with which blind individuals can read. Many libraries and schools provide books and magazines that are published in braille or have been recorded. The Library of Congress loans such books through its Division of the Blind and Physically Handicapped. Such organizations as the American Printing House for the Blind and Recording for the Blind, Inc., prepare braille and talking books.

Such devices as the *Optacon* and *optical scanners* enable people who are blind to read printed material. An Optacon forms an enlarged image of each letter, and the user reads by feeling the images with the fingers. Optical scanners are computers with a voice simulator that read printed material aloud.

Many motion pictures, videotapes, and television programs provide audio descriptions of action, scene



Illinois Visually Handicapped Institute (WORLD BOOK photo by Cameramann International, Ltd.)

A voice recording of *The World Book Encyclopedia* enables blind and partially blind people to use this reference work. The recorded edition includes cassette tapes and a special cassette player, *shown here,* and indexes in braille and large type.

changes, and other visual elements for people who are blind or partially sighted. At movie theaters, patrons hear a description of the onscreen action through a headset. TV and video programs have a descriptive soundtrack that runs along with the spoken dialogue.

Many blind people use a special cane when walking alone. The cane is painted white to identify the user as a blind person. Experienced cane users can get around confidently in unfamiliar places. Some blind people use trained dogs to guide them.

Education and training. The first school for blind people was established in Paris in 1784. The first such school in the United States, the New England Institution for the Education of the Blind (now Perkins School for the Blind) opened in Boston in 1832.

Until the mid-1900's, most people believed that blind children should be taught in special boarding schools. But today, more than 60 percent of blind children in the United States go to a regular day school. Some attend special classes for students who are blind or partly sighted, but others attend regular classes with sighted students. Many blind students go on to college.

Many agencies offer occupational training programs that teach blind people such skills as typing and operating various industrial machines. A number of these organizations provide job placement services for people who complete their programs. However, many blind people have difficulty finding someone who will hire them. Many employers believe mistakenly that all people who are blind—even skilled workers—cannot perform as productively as sighted workers.

Some agencies offer programs in such skills as cooking and personal grooming. Staff members also teach blind people how to use a cane. These experts, called *peripatologists*, help many blind people become familiar with their neighborhoods and teach them the best route to and from their jobs. Many United States government agencies offer help to blind people. They include the Bureau of Education for the Handicapped and the Office of the Blind and Visually Handicapped. In Canada, the Canadian National Institute for the Blind and the Canadian Federation of the Blind provide many services.

Such organizations as the American Foundation for the Blind (AFB) and the National Federation of the Blind (NFB) inform blind people of the services available to them. Information on blindness can be obtained from the National Blindness Information Center, located in Baltimore. David E. Eifrig

Related articles in *World Book* include:

American Printing House for the Blind	Dog guide
Braille	Eye
Braille, Louis	Eye bank
Bridgman, Laura Dewey	Glaucoma
Cataract	Iritis
Color blindness	Keller, Helen Adams
Conjunctivitis	Ophthalmia
Disabled	Snow blindness
	Trachoma

Additional resources

Alexander, Sally H. *Taking Hold.* Macmillan, 1994. *On My Own.* Farrar, 1997. Experiences of a woman who became blind as an adult. Younger readers.

Sardegna, Jill, and Paul, T. O. *The Encyclopedia of Blindness and Vision Impairment.* Facts on File, 1990.

Blindworm is the common name of a type of legless lizard that lives in Europe, western Asia, and northern Africa. A blindworm is not blind, nor is it a worm. It looks like a snake, but it is easily identified as a lizard because of its movable eyelids and fragile tail. People sometimes call it *slowworm.* It grows to about 20 inches

Bruce Coleman Inc.

The blindworm is really a legless lizard.

(50 centimeters) in length. A blindworm crawls with slow, snakelike movements and eats slugs. The blindworm is related to the *glass lizard* (see **Glass lizard**).

Raymond B. Huey

Scientific classification. The blindworm belongs to the alligator lizard family, Anguidae. Its scientific name is *Anguis fragilis.*

Blister is a collection of fluid below or between the surface layers of skin. Blisters are commonly the result of burns or continuous rubbing of the skin. However, they can also be caused by allergic reactions and certain diseases. Blisters that result from a sharp pinching of the skin can fill with blood.

The skin that covers a blister protects the tissues underneath from infection and further damage. Whenever possible, this skin should not be opened. When a blister is opened accidentally, it should be cared for like an open wound. Cleanse the area with soap and water, apply an antiseptic, and keep the wound clean with a bandage. If signs of infection appear, consult a physician. Critically reviewed by the American Red Cross

Blitzkrieg, *BLIHTS kreeg,* was a type of fast-moving warfare developed by the Germans in World War II. It means *lightning war.* Speedy *Panzer,* or mechanized troops, smashed holes in the enemy lines, then swept through, with dive bombers in support. The Russians developed *defense in depth* against blitzkrieg. They allowed the Germans to sweep through. Then, the Russians either escaped from their trap, or surrounded and destroyed the advancing Germans. German air raids on London and other British cities in 1940 and 1941 were called the Blitz. See also **World War II** (The invasion of Poland; The Battle of Britain). Peter Hoffmann

Blitzstein, *BLIHTS styn,* **Marc** (1905-1964), was an American composer noted for his satirical, sociopolitical works for the stage. He gained fame with *The Cradle Will Rock* (1937), a musical play attacking capital-

ism and social injustice. Blitzstein's other well-known work is the realistic opera *Regina* (1949), based on Lillian Hellman's play *The Little Foxes*. In *Regina*, Blitzstein used jazz, blues, and spirituals to heighten the dramatic effect. He translated and adapted from German into English the Kurt Weill-Bertolt Brecht musical play *The Three-Penny Opera*. The adaptation opened in New York City in 1954, where it ran for almost seven years.

Blitzstein died before completing *Sacco and Vanzetti*, an opera the Metropolitan Opera had commissioned. Blitzstein was born in Philadelphia. Richard Jackson

Blixen-Finecke, Karen. See Dinesen, Isak.

Blizzard is a blinding snowstorm with strong, cold winds. A blizzard occurs when a cold air mass moves out of the Arctic into the Temperate Zone. The advancing heavy, cold air forces the warmer, moist air to rise along the boundary between the two air masses. This boundary is called a *cold front*. The rising action produces a heavy snowstorm, which is accompanied by cold north winds. Many blizzards follow a period of unusually warm weather in winter.

The National Weather Service of the United States defines a blizzard as a storm with considerable falling or blowing of snow with winds of 35 miles (56 kilometers) per hour or more. The winds are accompanied by temperatures as low as 10 °F (−12 °C) and visibility less than 500 feet (150 meters). A *severe blizzard* has winds of more than 45 miles (72 kilometers) per hour accompanied by temperatures less than 10 °F and visibility approaching zero.

Blizzards occur most frequently in the northern Great Plains of the United States, in eastern and central Canada, and in various parts of Russia. They may pile up huge snowdrifts that completely disrupt daily life. Sometimes all transportation stops and businesses close down for several days. Margaret A. LeMone

Bloc Québécois, *blahk KAY beh KWAH,* is a Canadian political party that gives supporters of sovereignty for the province of Quebec a voice in Canada's Parliament. From 1993 to 1997, the Bloc served as Canada's official opposition party.

The Bloc Québécois was established in 1990 under the leadership of Lucien Bouchard, a former Canadian ambassador to France, minister of the environment, and member of the Progressive Conservative Party. The Bloc was founded shortly after the Meech Lake accord failed to win the approval of all of Canada's provinces. This accord had called for revising Canada's constitution. Many Quebecers felt the constitution did not adequately protect their province's French-Canadian heritage. The accord would have given more power to Quebec's provincial government and recognized Quebec as a distinct society in Canada. After the accord's defeat, some of Quebec's discontented Liberal and Progressive Conservative members of Parliament organized under the name Bloc Québécois.

The Bloc Québécois established links with the Parti Québécois, a powerful separatist party in Quebec's National Assembly. In addition, the Bloc Québécois built a strong party organization throughout Quebec.

J. L. Granatstein

See also **Bouchard, Lucien.**

Bloch, *blahk,* **Ernest** (1880-1959), was a prominent Swiss American composer of orchestral, chamber, and vocal music. He became well known for music that reflected his Jewish heritage. His compositions are noted for their emphasis on melody, harmonies that are usually tonal but often not traditional, and the influence of philosophical ideas and poetry.

Among Bloch's works are several that are often called the "Jewish cycle." They include *Three Jewish Poems* (1913) for orchestra; the *Israel Symphony* (1916) for five singers and orchestra; and *Schelomo* (1916), a rhapsody for cello and orchestra. Bloch adapted *Sacred Service* (1934) for baritone, chorus, and orchestra from the Saturday morning Jewish worship service. In addition, Bloch wrote chamber works, pieces for piano and for organ, and the opera *Macbeth* (1910).

Bloch was born in Geneva, Switzerland. He came to the United States in 1916 and became a U.S. citizen in 1924. Bloch served as director of the Cleveland Institute of Music from 1920 to 1925 and directed the San Francisco Conservatory of Music from 1925 to 1930. He also taught at the University of California from 1940 to 1952. Bloch's students included the American composers Douglas Moore and Roger Sessions. Daniel T. Politoske

Bloch, *blahk,* **Felix** (1905-1983), an American physicist, made important contributions to the theory of electrical and magnetic properties of solids. He shared the 1952 Nobel Prize in physics with another American physicist, Edward M. Purcell, for developing a simple but precise way of determining the magnetic properties of nuclei. In 1939, Bloch suggested an experiment to determine certain magnetic properties of uncharged nuclear particles called *neutrons*. Bloch was born in Zurich, Switzerland. He received a Ph.D. degree from the University of Leipzig in 1928 and became a professor at Stanford University in 1934. Robert H. March

Bloch, *blahk,* **Konrad Emil** (1912-2000), an American biochemist, discovered how animal cells produce a fatty substance called *cholesterol* from acetic acid. His findings are seen as an important step in learning how to control certain circulatory diseases. Bloch shared the 1964 Nobel Prize for physiology or medicine with biochemist Feodor Lynen of Germany for this work.

Bloch was born in Neisse, Germany (now Nysa, Poland). He taught at the University of Chicago and at Harvard University. Bloch began his work with cholesterol molecules in 1944. Eric Howard Christianson

Block, Herbert Lawrence (1909-2001), was a famous American editorial cartoonist who signed his work *Herblock*. He won the Pulitzer Prize for cartooning in 1942, 1954, and 1979.

Block was born in Chicago. He received a scholarship to the Art Institute of Chicago when he was only 12 years old. As a teen-ager, Block worked as a reporter for the Chicago City News Bureau. He attended Lake Forest College for two years and in 1929 became an editorial cartoonist for the *Chicago Daily News*. In 1933, he joined the Newspaper Enterprise Association as a syndicated cartoonist. In 1946, Block joined *The Washington Post*. Block gained nationwide prominence in the 1950's for cartoons criticizing Senator Joseph R. McCarthy, who charged, with little evidence, that many individuals were Communists. Creators Syndicate began distributing his cartoons to various publications in 1987.

Several books of Block's cartoons and comments on the news have been published. *Herblock Special Report*

"HELP!"
From the *Herblock Gallery* © 1968, Simon & Schuster

From the *Herblock Gallery* © 1968, Simon & Schuster

A Herblock cartoon illustrates the problems facing modern American cities. Block has been commenting on social and political problems in his editorial cartoons since the 1930's.

(1974) features more than 450 cartoons dealing with President Richard M. Nixon. Block's autobiography, *Herblock: A Cartoonist's Life* (1993), includes favorite cartoons by the author. Lee B. Jolliffe

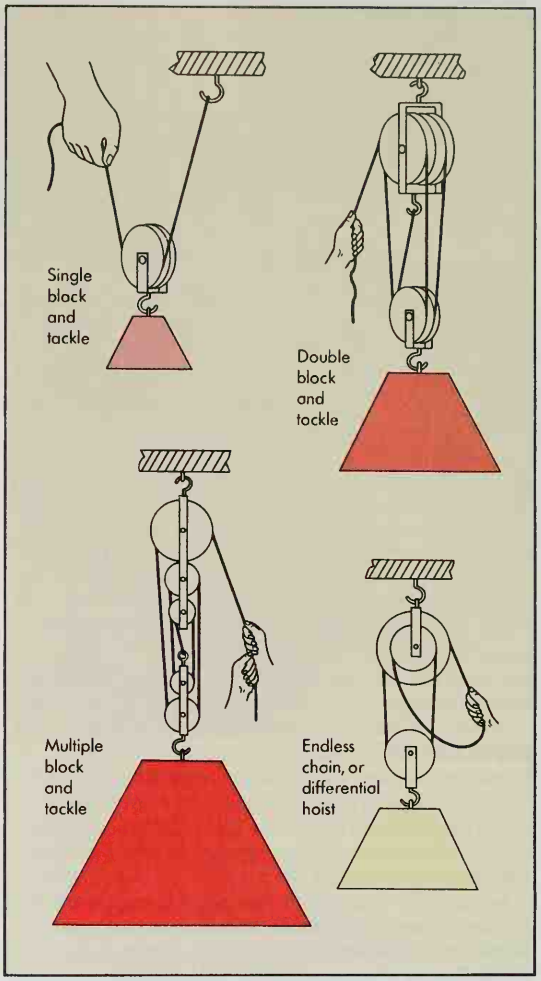
Block and tackle is a machine used to lift weights and to exert large forces. It is made of ropes and pulleys. The pulleys are mounted in frames called *blocks*. Each block has a hook by which it can be fastened to its support or to the load. A *single block* has one pulley, a *double block* has two pulleys, and so on.

Mechanical advantage. The *ideal mechanical advantage* of a block and tackle equals the number of sections of rope that support the movable block. A single block and tackle has an ideal mechanical advantage of 2. Therefore, if friction did not act, a one-pound pulling force could lift a two-pound weight. However, since friction always acts, the weight that could be lifted with a one-pound pulling force would be less than two pounds. Therefore, the *actual mechanical advantage* would be less than 2.

Additional pulleys decrease the distance the load moves, to the same extent that additional pulleys increase the ideal mechanical advantage. A 10-pound effort will lift 20 pounds with a single block. But the 10-pound effort must be moved 12 inches to make the 20 pounds move 6 inches. With a double block, a 10-pound effort will lift 40 pounds. But the effort must be moved 12 inches to make the 40 pounds move 3 inches.

Endless chain hoist, also called a *differential hoist,* has one pulley below to which the load is fastened. The upper block has two pulleys of different sizes. These pulleys are joined so that they turn together.

To raise the load, the upper pulleys are turned by pulling on the chain leading from the larger pulley. As it



WORLD BOOK illustration by Arthur Grebetz

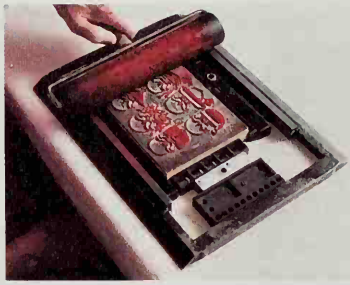
Block and tackle is a machine used to perform such tasks as lifting weights and moving heavy machinery. Various types of block and tackle have different combinations of pulleys.

turns, the larger pulley raises one of the chains that support the load. At the same time, the smaller pulley lowers the other chain. Because the pulleys differ in size, the larger one raises one chain more than the smaller pulley lowers the other chain. As a result of this difference, the load is raised. The ideal mechanical advantage of the differential hoist equals the diameter of the larger pulley divided by the difference between the diameters of the two pulleys. James D. Chalupnik

See also **Crane; Pulley; Wheel and axle.**

Block printing is a method of reproducing a picture in which the artist uses a thin block of wood, linoleum, or similar material to make the image. Block printing is one of the most important kinds of printmaking.

In block printing, the artist first sketches the picture on the block with a pencil or pen. The lines and areas to be printed are left untouched, but the rest of the block is slightly cut away with knives or chisels called *gouges*. Next, the artist spreads thick ink on the raised, uncut parts of the block with a *brayer* (roller). Then a sheet of



WORLD BOOK photos by Cameramann International, Ltd.

Making a block print. The artist cuts a picture into a block of linoleum with a sharp tool, *left.* To make a print of the picture, the surface of the block is coated with ink, *center.* Then a sheet of paper is pressed onto the block, transferring the inked image onto the sheet, *right.*

paper is pressed onto the block, transferring the inked image onto the paper. The print on the paper is a reverse image of the drawing on the block. To print a picture in several colors, the artist must cut a different block for each color.

Most historians believe that the Chinese invented block printing during the 600's. The technique was first used in Europe in the 1200's to print designs on fabrics. In the 1300's, paper first became widely available in Europe. Artists were soon using paper to create religious pictures and playing cards. Since the late Middle Ages, many artists have used the block-printing technique to make woodcuts. Elizabeth Broun

See also **Hokusai** (picture); **Japanese print; Woodcut.**

Blockade is the patrolling of an enemy country's coasts by warships and planes to keep the country from receiving goods it needs to wage war. Nations with adequate naval forces can use the blockade to keep their enemies from getting arms, munitions, and even food from neutral countries.

No nation has the right to declare a blockade unless it has the power to enforce it, according to international law. This rule was established by the Declaration of Paris at the close of the Crimean War in 1856. Other rules for blockade were set down in the Declaration of London in 1909. This stated that a country must declare a blockade formally and must notify neutral nations. The Declaration of London also provided that a blockade must not be extended beyond the coasts and ports belonging to or occupied by an enemy.

A different kind of blockade, used by both the United Kingdom and the United States in World War II, was the *blacklist.* This listed business firms and individuals in neutral countries who were trading with the enemy. The companies and individuals on the blacklist were not allowed to buy goods from the United States or the United Kingdom. Some authorities considered this a form of blockade because it kept Germany, Japan, and Italy from getting goods which could otherwise have been bought for them by neutrals.

Paper blockade is a blockade which has been declared by a nation that does not have the power to enforce it. Napoleon declared such a blockade against the United Kingdom in 1806, and the United Kingdom declared one in return against France (see **Continental System**). Both countries then seized neutral vessels for their own use. The German submarine blockade of the United Kingdom and Ireland in World War I was considered by other countries to be a paper blockade. A real blockade is established only when an area is guarded by a naval force so large that a merchant ship finds it almost impossible to "run the blockade" and bring a cargo into the affected area.

Pacific blockade is a blockade established in peacetime. President John F. Kennedy ordered a pacific blockade of Cuba in 1962 to halt shipments of missiles to that country (see **Cuban missile crisis**). A nation may also use a pacific blockade to force another nation to do what it wants. In this case, the blockade applies only to ships of the nation being blockaded. Many international law authorities believe such a blockade is not legal.

Robert J. Pranger

See also **Contraband; Embargo.**

Blockhouse is a small fort built of logs or timbers. It may be part of a larger defense system. Pioneer settlers of the United States and Canada used blockhouses as a defense against Indian attacks. A typical blockhouse was a two-story square tower. It had room for 25 to 100 defenders who fired at the enemy through small openings in the walls. The second story sometimes had an overhang that extended over the first story walls. In North America, defenders kept Indians with *firebrands* (pieces of burning wood) away from the walls by firing at them from the overhang. Blockhouses were useless against enemy artillery fire. The Normans built structures similar to blockhouses after they conquered England in 1066.

Robert A. Becker

See also **Pioneer life in America** (Pioneers and Indians).

Bloemfontein, *BLOOM fahn TAYN* (pop. 126,867; met. area pop. 300,150), is the judicial capital of South Africa. The Supreme Court of Appeal, one of South Africa's highest courts, meets in Bloemfontein. Cape Town is South Africa's legislative capital, and Pretoria is its administrative capital. Bloemfontein also serves as the capital of the Free State, a province of South Africa. Bloemfontein is an Afrikaans word meaning *fountain of flowers.* Afrikaans is an official language of South Africa. For location, see **South Africa** (political map).

In the 1830's and 1840's, white settlers called Boers conquered local black African farmers and settled in the area that is now Bloemfontein. Today, more blacks than whites live in Bloemfontein. Most of them speak *Sesotho,* the language the local farmers spoke before the white conquest. Bloemfontein has a university and an agricultural school. Bruce Fetter

Granger Collection

© Patrick Watson, Medichrome

The importance of blood has been appreciated since ancient times, but knowledge of blood's role in health and disease has changed significantly. For thousands of years, people believed that bloodletting would allow illness to flow out of a sick person. The woodcut above shows a physician bleeding a patient during the 1500's. Today, doctors know that giving blood—not removing it—can save lives. The photo at the right shows a patient receiving a blood transfusion.

Blood

Blood is the river of life that flows through the human body. We cannot live without it. The heart pumps blood to all our body cells, supplying them with oxygen and food. At the same time, blood carries carbon dioxide and other waste products from the cells. Blood also fights infection, keeps our temperature steady, and carries chemicals that regulate many body functions. Finally, blood even has substances that plug broken blood vessels and so prevent us from bleeding to death.

When oxygen combines with certain cells—the red blood cells—the blood takes on its characteristic red color. Thus, blood that escapes from the body through a broken vessel appears bright red because of the oxygen in the air. Blood carrying oxygen to body cells has that same brilliant red color. But it turns a dark brownish-red after delivering oxygen.

The amount of blood in your body depends on your size and the altitude at which you live. An adult who weighs 160 pounds (73 kilograms) has about 5 quarts (4.7 liters) of blood. An 80-pound (36-kilogram) child has about half that amount, and an 8-pound (3.6-kilogram) infant has about $8\frac{1}{2}$ ounces (250 milliliters). People who live at high altitudes, where the air contains less oxygen, may have up to 2 quarts (1.9 liters) more blood than people who live in low regions. The extra blood delivers additional oxygen to body cells.

This article discusses the blood of human beings. Blood also circulates through the bodies of dogs, cats, birds, insects, and most other kinds of animals. Only such simple animals as jellyfish and sponges do not need blood to live. For information about blood in some types of animals, see **Circulatory system** (The circulatory system in other animals). See also **Mammal** (Internal organ systems); **Insect** (Circulatory system).

G. David Roodman, the contributor of this article, is Professor of Medicine at the University of Texas Health Science Center at San Antonio and Chief of Hematology at the Audie L. Murphy Memorial Veterans Hospital.

The composition of blood

Blood consists of cells that move about in a watery liquid called *plasma.* The cells are known as *formed elements* because they have definite shapes. Three types of cells make up the formed elements: (1) red blood cells, (2) white blood cells, and (3) platelets. A microliter ($\frac{1}{30,000}$ of an ounce) of blood normally contains about 4 million to 6 million red blood cells, 5,000 to 10,000 white blood cells, and 150,000 to 500,000 platelets. The red and white blood cells are also called *corpuscles.*

Plasma is the liquid, straw-colored part of blood. It makes up about 50 to 60 per cent of the total volume of blood. The formed elements account for the rest.

Plasma consists of about 90 per cent water. Hundreds of other substances make up the balance. They include proteins that enable blood to clot and to fight infection; dissolved *nutrients* (foods); and waste products. Plasma also carries chemicals called *hormones,* which control

growth and certain other body functions.

Red blood cells, also called *erythrocytes* (pronounced *ih RIHTH roh sytz*), carry oxygen to body tissues and remove carbon dioxide. A red blood cell has a flat, disklike shape. It is thinner in the middle than at the edges—somewhat like a doughnut without the hole.

Red blood cells consist mainly of *hemoglobin* (*HEE muh GLOH buhn*), an oxygen-carrying protein that gives them their red color. The cells also contain chemicals, particularly *enzymes.* Enzymes enable the cells to carry out necessary chemical processes more effectively. A flexible membrane surrounds each red blood cell. The membrane is so flexible the cells can squeeze through the tiniest blood vessels. Most kinds of cells have a *nucleus,* a central structure that controls many cell activities. But mature red blood cells have no nuclei.

White blood cells, also called *leukocytes* (*LOO kuh sytz*), fight infections and harmful substances that invade the body. Most of the cells are round and colorless. They have several sizes, and their nuclei vary in shape. Some kinds of white blood cells kill bacteria by surrounding and digesting them. Other kinds produce *antibodies,* proteins that destroy bacteria, viruses, and other invaders or make them harmless.

Platelets (*PLAYT lihtz*), also known as *thrombocytes* (*THRAHM buh sytz*), are disklike structures that help stop bleeding. They are the smallest formed elements. If a blood vessel is cut, platelets stick to the edges of the cut and to one another, forming a plug. They then release chemicals that react with *fibrinogen* (*fy BRIHN uh juhn*) and certain other plasma proteins, leading to the formation of a blood clot.

What blood does in the body

The major jobs of blood are to transport oxygen and nutrients to body tissues and to remove wastes. To accomplish those tasks, blood must flow to all parts of the body. It does so by means of our circulatory system, which consists of the heart, a vast network of blood vessels, and the blood itself.

The heart pumps blood to all the body tissues. Blood leaves the heart through arteries and returns through veins. Within the tissues, the arteries become smaller and smaller. The smallest blood vessels are the *capillaries.* They connect the tiniest arteries and the tiniest veins. Oxygen, food, and other substances pass from the blood through the thin capillary walls into the tissues. Carbon dioxide and other wastes from the tissues also pass through the capillary walls and enter the bloodstream. Blood returns to the heart through ever-larger veins. For more information about how blood moves through the body, see **Circulatory system; Heart.**

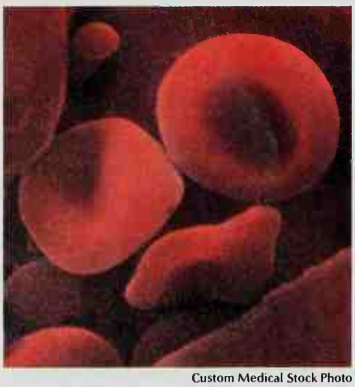
Carrying oxygen and carbon dioxide. All living cells in your body continuously absorb oxygen and give off carbon dioxide. Oxygen is carried to your body tissues mainly by hemoglobin in the red blood cells. Each molecule of hemoglobin binds easily with four molecules of oxygen. When you inhale, air enters the *alveoli* (air sacs) of your lungs. Oxygen from the air passes through the walls of the capillaries that surround each alveolus and binds with hemoglobin. Some oxygen also dissolves in the plasma. The bonds that hold hemoglobin and oxygen molecules together react to oxygen levels in the cells. If the oxygen levels are low, the bonds break easily, releasing oxygen.

Your cells use oxygen to produce energy. The process creates carbon dioxide, which passes from the cells through the capillary walls. Most carbon dioxide enters the plasma, but some attaches to hemoglobin. When the blood reaches the capillaries in your lungs, the carbon dioxide enters the alveoli and is exhaled. See **Hemoglobin; Lung; Respiration** (Gas transport between the lungs and tissues).

Transporting nutrients and wastes. Food reaches your body tissues by means of the blood. After food passes through your stomach, it enters the small intestine, where digestion is completed. The wall of the small intestine has millions of tiny, fingerlike projections called *villi.* The villi absorb digested food molecules, which enter the capillary network of each villus and pass into the blood. Many nutrients bind with the plasma protein *albumin,* which carries them to body tissues.

Blood cells

Blood contains three types of cells, which perform many vital tasks. (1) Red blood cells carry oxygen to body tissues. (2) White blood cells help the body fight infection and disease. (3) Platelets plug leaks in blood vessels and help begin the process leading to the formation of a blood clot.



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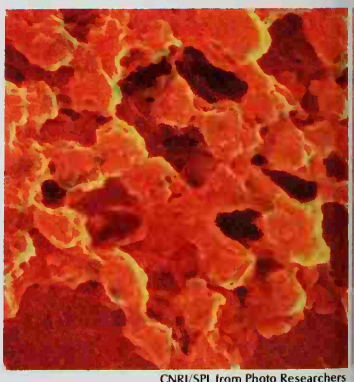
Red blood cells

NIBSC/SPL from Photo Researchers

White blood cell



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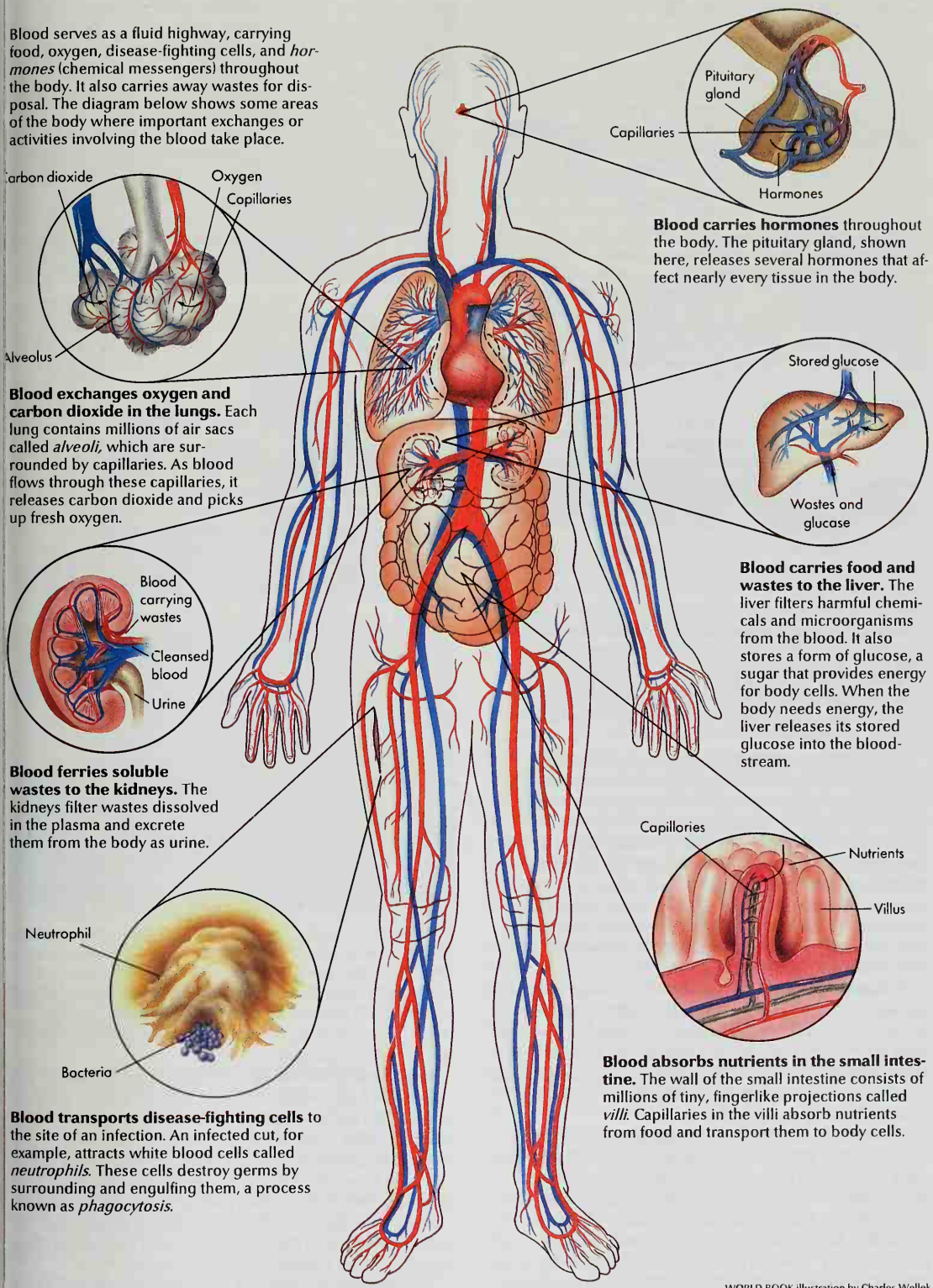
Platelets

What blood does in the body

Blood serves as a fluid highway, carrying food, oxygen, disease-fighting cells, and *hormones* (chemical messengers) throughout the body. It also carries away wastes for disposal. The diagram below shows some areas of the body where important exchanges or activities involving the blood take place.



Blood carries hormones throughout the body. The pituitary gland, shown here, releases several hormones that affect nearly every tissue in the body.

Blood exchanges oxygen and carbon dioxide in the lungs. Each lung contains millions of air sacs called *alveoli,* which are surrounded by capillaries. As blood flows through these capillaries, it releases carbon dioxide and picks up fresh oxygen.

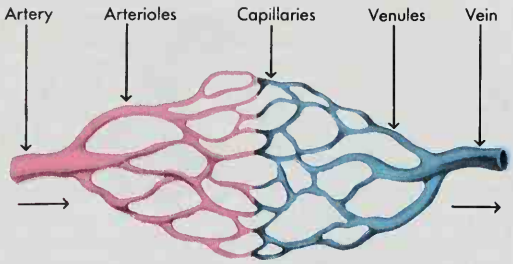
Blood carries food and wastes to the liver. The liver filters harmful chemicals and microorganisms from the blood. It also stores a form of glucose, a sugar that provides energy for body cells. When the body needs energy, the liver releases its stored glucose into the bloodstream.

Blood ferries soluble wastes to the kidneys. The kidneys filter wastes dissolved in the plasma and excrete them from the body as urine.

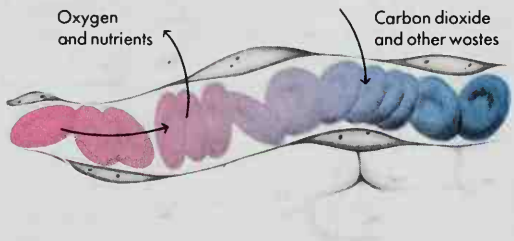
Blood absorbs nutrients in the small intestine. The wall of the small intestine consists of millions of tiny, fingerlike projections called *villi.* Capillaries in the villi absorb nutrients from food and transport them to body cells.

Blood transports disease-fighting cells to the site of an infection. An infected cut, for example, attracts white blood cells called *neutrophils.* These cells destroy germs by surrounding and engulfing them, a process known as *phagocytosis.*

WORLD BOOK illustration by Charles Wellek



Capillaries form an "exchange system" for the blood. Blood, carrying food and oxygen, flows from the arteries, through the smaller arterioles, into the capillaries. In the capillaries, the blood exchanges food and oxygen for waste materials that are given off by the body cells. The blood returns the wastes to the heart by way of venules and veins. Then the heart pumps the wastes to such organs as the liver, lungs, and kidneys, where the wastes are removed.



Most capillaries are so small that blood cells must pass through them in single file. Food and oxygen needed by the cells of the body ooze out through the thin capillary walls. Carbon dioxide and other waste materials from the body cells squeeze back through the walls into the bloodstream. The blood then returns these waste materials to the heart.

Your cells use nutrients to produce the energy needed for cell growth, reproduction, and other functions. In producing energy, the cells create waste products. Like nutrients, wastes enter the bloodstream through the capillary walls. Many wastes bind with albumin or dissolve in the plasma, which transports them to the liver. The liver filters wastes and other harmful substances from the blood. It converts some wastes into a compound called *urea.* The blood carries urea to the kidneys, which remove it in urine. See **Digestive system; Intestine; Liver; Kidney.**

Protecting against disease. White blood cells play an important role in your *immune system,* which helps your body resist disease-causing substances. The invasion of a harmful substance activates the white blood cells. They then work to destroy it. Some proteins in the plasma also help fight disease. There are five main groups of white blood cells.

Three kinds of white blood cells attack and destroy germs, especially bacteria, in a process called *phagocytosis* (*FAG uh sy TOH sihs*). In phagocytosis, a white blood cell surrounds a germ and then kills it with enzymes. Such white blood cells are called *phagocytes.*

Neutrophils (*NOO truh fihlz*) are the most numerous phagocytes. They fight mainly bacterial infections. When bacteria invade the body, neutrophils leave the bloodstream and travel to the infected area. *Monocytes* (*MAHN uh sytz*), like neutrophils, leave the bloodstream and migrate to infected tissues, where they mature and become *macrophages* (*MAK ruh fayj uhz*). Macrophages not only kill germs but also destroy cancer-causing cells. In addition, they help begin antibody production. *Eosinophils* (*EE uh SIHN uh fihlz*), a rare third kind of phagocyte, defend the body against parasites.

Members of a fourth group of white blood cells, *lymphocytes* (*LIHM fuh sytz*), do not perform phagocytosis. Instead, they have a key part in the body's immune system by recognizing and responding to specific viruses, bacteria, and other invaders. There are two major kinds of lymphocytes—*B cells* and *T cells.* B cells produce antibodies and release them into the plasma, where they circulate in the form of *globulin proteins.* Such proteins, especially *gamma globulin,* fight infection (see **Globulin; Gamma globulin**). T cells release substances that control B-cell activity. They also produce substances that activate monocytes and so help destroy harmful organisms.

The chief function of a fifth group of white blood cells, *basophils* (*BAY suh fihlz*), is uncertain. Like eosinophils, they are rare blood cells.

To learn more about how white blood cells help us fight disease, see **Immune system.**

Carrying hormones. Organs called *endocrine glands* produce hormones and release them directly into the blood. The hormones enter the plasma and act as "chemical messengers." When a hormone reaches a part of the body it regulates, it may affect growth, reproductive processes, how the body uses food, or some other function. See **Hormone; Gland.**

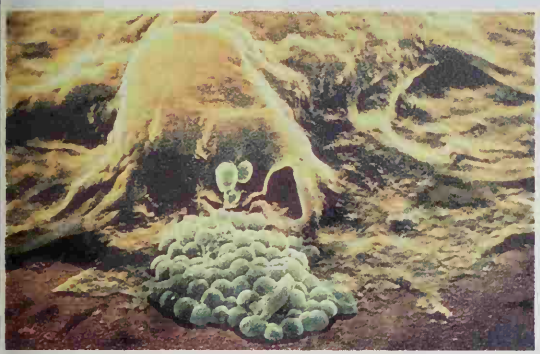
Distributing body heat. All cell activities produce heat. But some cells, particularly those in muscles and glands, create more heat than others. The heat enters your bloodstream and travels throughout your body. Excess heat escapes through your skin. If blood did not distribute heat, some body areas would become extremely hot while others would remain extremely cold. Thus, blood circulation helps keep your body temperature steady and safe.

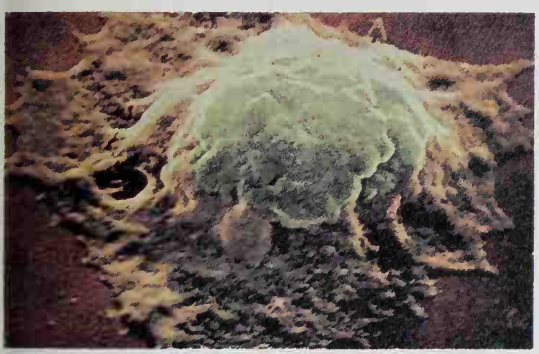
How the body maintains its blood supply

You cannot live without a proper supply of healthy blood. In addition, the amounts of the various blood *components* (parts) must change constantly as the needs of your body change. Substances called *hematopoietic growth factors* govern the production of the red cells, white cells, and platelets. Your body maintains its blood supply by (1) regulating the volume of blood components, (2) controlling bleeding, and (3) replacing worn-out blood components.

Regulating the volume of blood components. The volume of each blood component continuously adjusts to meet the body's needs. The plasma proteins, especially albumin, control the movement of plasma between the capillaries and the cells. Normally, only dissolved substances, such as nutrients, pass from the plasma through the capillary walls. But if the amount of albumin falls below normal, plasma may escape into tissues. In contrast, if the concentration of albumin is high, water from the tissues enters the plasma.

The volume of red blood cells depends on how much oxygen body tissues require. The kidneys produce a





Lennart Nilsson from his book *Behold Man* published in the U.S. by Little, Brown & Co., Boston

The destruction of bacteria by a macrophage—a kind of white blood cell—is shown above. In the top photo, the macrophage approaches a cluster of bacteria. In the middle photo, the macrophage has begun to surround the germs. In the bottom photo, the macrophage has engulfed the bacteria, which it will destroy with enzymes.

hormone called *erythropoietin* that stimulates output of the cells. When the tissues need oxygen, the kidneys produce increased amounts of erythropoietin, causing red-cell production to rise. When oxygen need falls, erythropoietin output drops. Certain diseases also may reduce the production of red blood cells.

Other hematopoietic growth factors control the number of white blood cells and platelets, which also increase and decrease according to the condition of the body. For example, an infection leads to a rise in the number of germ-fighting white blood cells. Similarly, severe bleeding can cause an increase in the number of platelets, thus improving the blood's ability to clot.

Controlling bleeding. You would bleed to death from a small cut if your blood did not *coagulate* (clot). An injured blood vessel causes platelets to stick to the damaged surface and to one another, forming a plug.

The plasma contains proteins called *clotting factors.* They normally circulate in an inactive form in the blood. But if a blood vessel suffers damage, the platelet plug and the injured vessel give off chemicals that react with the clotting factors. Eventually, the plasma protein fibrinogen changes into sticky strands of *fibrin.* The strands crisscross one another, creating a mesh that holds red blood cells and the platelet plug tightly to the site of bleeding. The fluid is squeezed out, and a solid plug—the clot—forms. A clot on the skin surface is a scab.

Occasionally, a clot may occur in an undamaged vessel that has no bleeding. Such a clot, called a *thrombus,* may block the flow of blood to tissues beyond the clot and cut off food and oxygen to those tissues. If a clot blocks an artery that nourishes the heart, a *coronary thrombosis* results, which may cause a heart attack (see **Coronary thrombosis**). If a clot blocks an artery to the brain, a stroke may occur (see **Stroke**).

Blood contains substances that dissolve clots as well as produce them. These substances circulate in an inactive form until clotting occurs. They are then activated to control the extent and duration of the clotting.

Replacing worn-out blood components. Each formed element can live only a particular length of time, and so your body must continuously replace worn-out cells. Red blood cells live about 120 days, and platelets about 10 days. The life span of white blood cells varies greatly. For example, neutrophils live only a few hours, dying soon after they perform phagocytosis. But some lymphocytes live many years, thus providing long-term immunity against certain diseases.

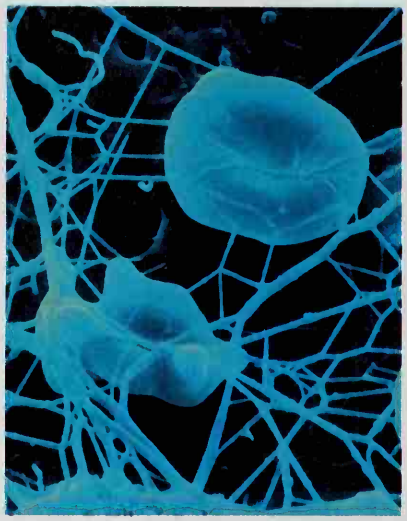
Destruction of worn-out blood components. Two body organs—the liver and the spleen—remove worn-out red blood cells from the bloodstream and break them down. The liver uses coloring matter from the old cells in producing a digestive liquid called *bile.* The iron from hemoglobin is reused by the body to make new red blood cells. Worn-out white blood cells migrate to body tissues, where they die. Platelets probably wear out plugging tiny leaks in blood vessels.

Formation of new blood components. The core of human bones is filled with a soft red or yellow substance called *marrow.* In adults, the red bone marrow produces millions of blood cells per second. Red marrow occurs mostly in flat bones, such as the vertebrae, ribs, and skull. All blood cells begin in the marrow as *stem cells.* They develop into more mature *precursor cells* for each type of blood cell, each of which forms either many red blood cells, white blood cells, or platelets.

As red blood cells develop in the marrow, they make hemoglobin. They also shrink and lose their nuclei. At maturity, they enter the bloodstream through tiny blood-filled cavities, called *sinuses,* in the marrow.

Although all white blood cells originate in the red bone marrow, lymphocytes—the T cells and B cells—mature elsewhere in the body. T cells enter the bloodstream through the sinuses and move to the *thymus,* a gland near the base of the neck, where they complete their development. The mature T cells then travel to

NIBSC/SPL from Photo Researchers



© Manfred Kage from Peter Arnold

Clotting helps prevent blood loss from an injured vessel. Platelets immediately stick to the surface of a damaged blood vessel, forming a temporary plug at the site of injury, *far left.* A series of chemical reactions then takes place. Eventually, sticky strands of a substance called *fibrin* form a mesh that traps red blood cells, creating a clot, *near left.*

structures called *lymph nodes,* which occur in many areas of the body. B cells complete their maturation in the lymph nodes and spleen.

Platelets develop in the red marrow from large precursor cells called *megakaryocytes* (*MEHG uh KAR ee uh sytz*). They eventually split into fragments, each of which becomes a platelet and enters the bloodstream.

Blood groups

The membranes of red blood cells contain proteins called *antigens.* More than 300 red-cell antigens have been identified. Based on the presence or absence of particular antigens, scientists have classified human blood into various groups.

The significance of blood groups. Blood-group classifications have extreme importance in certain medical procedures. Information about blood groups has also been used in law and anthropology.

In medicine, the chief use of blood groups is to determine whether the blood of one person, called a *donor,* can be transfused into the body of a patient without rejection or serious reaction. In almost every person, the plasma contains antibodies that react to certain antigens not present on the surface of that person's own red blood cells. During a transfusion, dangerous clumping of the red blood cells may occur if antibodies in the patient's plasma bind to antigens on the donor's red blood cells. The clumping can block small blood vessels and result in severe illness or even death. No one's plasma normally contains antibodies that bind with the person's own red-cell antigens.

The most serious transfusion reaction is the rapid destruction of the transfused red blood cells. This may lead to shock, kidney failure, and sometimes death. Other reactions may include fever, shaking, and chills.

Before a patient has a blood transfusion, hospitals always perform a *cross-match,* a test in which a sample of the donor's red blood cells is mixed with a sample of the patient's plasma. If clumping occurs, the patient does not receive blood from that donor. Cross-matching thus reduces the possibility of dangerous transfusion reactions.

The membranes of white blood cells carry proteins called *HLA antigens.* Physicians use the presence of those antigens to help determine whether an organ or tissue from a certain donor can be safely transplanted into a patient (see **Transplant**).

In law. In the past, law enforcement officials have used blood groups to help uncover the identity of criminals. For example, a blood specimen from the scene of a crime can be compared with that of a suspect. Today, DNA analysis is used to more accurately identify blood specimens.

The antigens on red blood cells are inherited, and so blood tests have been used in *paternity cases,* in which a man is accused of being a child's father. The tests cannot prove that a certain man fathered a certain child, but they can sometimes prove that he did not. The use of blood groups in paternity and other parenthood cases has been largely replaced by studies of the *DNA molecules* in blood cells. DNA carries hereditary information in all the body cells, and such tests are almost 100 per cent accurate in determining parenthood.

In anthropology. Many anthropologists have used blood-group frequencies to separate people into races and subraces. But that method of racial identification has not been successful. Blood-group antigens apparently do not differ among races, possibly because the races have intermarried throughout the ages.

The ABO blood groups make up the leading system of blood classification. The system classifies human blood into four main types, or groups. The types are based on the presence or absence of two antigens, called *A* and *B,* on the surface of red blood cells. (1) If the cells have only antigen A, the blood is *type A.* The plasma contains *anti-B* antibodies, which clump cells having antigen B. (2) If the red cells have only antigen B, the blood is *type B.* The plasma contains *anti-A* antibodies, which clump cells having antigen A. (3) If the cells have both antigens A and B, the blood is *type AB.* The plasma contains neither anti-A nor anti-B antibodies. (4) If the red cells have neither antigen A nor antigen B, the blood is *type O.* The plasma contains both anti-A and anti-B antibodies. Worldwide, type O blood is the most

Transfusion reactions between ABO blood types

Safe combinations	
Blood type of donor	**Blood type of patient**
Type AB	Type AB
Type A	Type AB or A
Type B	Type AB or B
Type O	Type AB, A, B, or O
Unsafe combinations	
Blood type of donor	**Blood type of patient**
Type AB	Type A, B, or O
Type A	Type B or O
Type B	Type A or O

Normal reaction

© Martin M. Rotker, Phototake

Clumping reaction

Before a blood transfusion, doctors mix samples of the donor's red blood cells and the patient's plasma to make sure no unsafe reactions will take place. Combining certain blood types causes red cells in the donor blood to *clump* (stick together). Clumping may block small blood vessels and cause the patient to become seriously ill or even die.

common, followed by type A. Relatively few people have type B, and even fewer have type AB.

Doctors prefer to use donor blood of the same ABO type as that of the patient to avoid clumping during a transfusion. But in an emergency, type O blood may be transfused into patients of any blood type. Similarly, type AB patients may be able to receive any ABO blood in an emergency because they have no antibodies to A or B antigens. But even then, hospitals perform a cross-match to ensure that no clumping will occur. Type A patients should never receive type B blood, and type B patients should never receive type A blood.

In most cases, it does not matter if the donor's plasma contains antibodies that clump the patient's red blood cells. The plasma dilutes rapidly in the patient's blood, making the risk of clumping slight.

Rh blood types form the second major blood-group system. People who have Rh antigens on their red blood cells are *Rh positive*. The antigen itself is called the *Rh factor*. People who lack the factor are *Rh negative*. Most people are Rh positive.

Plasma has no natural antibody to the Rh antigen. But Rh-negative people may build up antibodies called *anti-Rh* if they receive a transfusion of Rh-positive blood. The donor blood usually dilutes quickly, and so the antibodies create no problems. But clumping will occur later if an Rh-negative patient receives another transfusion of Rh-positive blood, which causes the anti-Rh to attack the Rh-positive blood. A mixing of Rh-negative and Rh-positive blood can also happen if an Rh-negative woman becomes pregnant with an Rh-positive baby. If some of the baby's red blood cells enter the woman's blood, anti-Rh may build up in her plasma. The situation can cause serious problems if the mother later becomes pregnant with another Rh-positive baby. See **Rh factor.**

Other blood groups. Many other systems for classifying blood have been developed. They include the Duffy, Kell, Kidd, Lewis, Lutheran, MNS, and P systems. But natural antibodies to the antigens in those systems occur rarely. Aside from the A and B antigens of the ABO system and the Rh factor, most red-cell antigens do not produce strong or dangerous reactions.

Medical uses of blood

Blood transfusions. The ability to transfuse blood or blood components into sick or injured people has saved countless lives and revolutionized patient care. If an adult suddenly loses more than 1 quart (0.9 liter) of blood, death may occur unless the person receives a transfusion. Transfusions can also help patients whose bone marrow does not produce enough blood cells. In addition, transfusions replace blood lost during surgery.

Blood banks collect blood from donors and store it in sterile bags with a preservative and a chemical to help prevent clotting. Generally, patients need only one blood component, such as red blood cells. For that reason, blood banks separate most whole blood into components before storage. Whole blood can be refrigerated and stored for 21 to 49 days. Plasma, red blood cells, and certain other components can be frozen and stored up to several years.

Some diseases may be transmitted from a donor to a patient through a transfusion. Laboratory workers therefore screen all donated blood for the presence of hepatitis, AIDS, and certain other infectious diseases. In addition, a cross-match must ensure that no dangerous reactions will result. See **Blood transfusion.**

Blood tests. Doctors use two main types of blood tests: (1) screening tests and (2) diagnostic tests.

Screening tests help physicians detect unsuspected problems in patients. For example, a *blood count* calculates the number of red and white cells and the amount of hemoglobin in a sample of blood (see **Blood count**). A *hematocrit* measures the volume of red blood cells compared with other blood components. Abnormalities revealed by either test may indicate a disease or a defect in blood-cell production.

Doctors use various other blood tests to detect certain diseases. For instance, a test that shows a high level of *glucose* (sugar) in the blood may indicate diabetes, a disease in which the body does not use sugar normally (see **Diabetes**). A blood test that reveals a high level of the waste product urea may indicate a disorder of the kidneys, which filter urea from the blood. Physicians also screen patients' blood for high levels of cholesterol, which has been associated with an increased risk of heart disease (see **Cholesterol**).

Diagnostic tests help doctors discover the causes of some conditions. For example, *anemia* (an abnormally low number of red blood cells) may result if the diet does not include enough iron, vitamin B_{12}, or folic acid. The size of a patient's red blood cells can reveal which nutrient the body needs. If the anemia results from too little iron, for example, the red cells are unusually small. But if it results from not enough vitamin B_{12}, the cells are unusually large.

A *differential white count test* tells a doctor the percentage of each type of white blood cell in a patient's blood. An extremely high number of white blood cells may mean *leukemia,* a form of cancer. On the other hand, a low neutrophil count may indicate an inability to fight infections effectively. Such diagnostic tests as a *platelet count* and a *clotting test* help physicians learn of certain bleeding disorders. The tests may also be performed before an operation to determine if the patient might bleed excessively during surgery.

Blood disorders

Disorders of the blood involve overproduction, underproduction, or excessive destruction of blood cells. Certain infections also can affect the blood.

Anemia results from abnormally low levels of red blood cells or hemoglobin. A severely anemic person's blood carries too little oxygen to meet the needs of body tissues.

Various conditions may cause anemia. One main cause is insufficient production of red blood cells by the bone marrow. The underproduction may stem from nutritional deficiency, disease, or infection. In addition, blood loss from an injury often results in anemia. Excessive *hemolysis* (destruction of red blood cells) may also cause anemia. Two hereditary diseases—*sickle cell anemia* and *thalassemia*—involve hemoglobin abnormalities. Physicians use diet therapy, drugs, transfusions, or a bone marrow transplant to treat anemia, depending on its cause.

White-cell abnormalities. Acute leukemia results from uncontrolled and excessive white blood cell production. Physicians do not know exactly what causes the cancer. They use drugs, radiation, transfusions, or a bone marrow transplant to treat it.

The blood has an unusually low number of white blood cells in a disorder called *leukopenia.* It can result from exposure to certain drugs, diseases, or infections. In *neutropenia,* the most common type of leukopenia, the number of neutrophils is sharply reduced. People with neutropenia have an increased risk of infection because their blood lacks enough neutrophils to defend the body against harmful bacteria.

Bleeding disorders come from a disruption of the blood's ability to clot. Most such disorders result from abnormally low levels of clotting factors in the plasma or from an abnormality of the platelets.

A lack of some clotting factors causes *hemophilia,* a hereditary condition in which the blood coagulates extremely slowly. Hemophiliacs risk sudden, unexplained bleeding; severe bleeding from minor injuries; and bleeding of the joints and internal organs. Physicians treat the disorder by injecting the patient with the missing clotting factor.

Platelet abnormalities also affect the blood's clotting ability. People with *thrombocytopenia*—that is, an unusually low number of platelets—risk dangerous episodes of bleeding. The low platelet count may be caused by certain drugs, infections, or increased platelet use by the body. People with *thrombocythemia*—that is, an excessive number of platelets—may also risk abnormal bleeding as well as abnormal clotting. A shortage of iron or the presence of cancer or certain other diseases may produce the high platelet count. Treating the causes of both conditions usually corrects them.

Infections. Various infections can attack the blood. For example, infectious organisms can poison the blood and spread throughout the body. In *malaria,* a parasite destroys the red blood cells. In *mononucleosis,* a virus infects the B cells. In AIDS, a virus infects the T cells and damages the immune system.

History of blood research

Scientific interest in blood probably began with the Greek physician Hippocrates, who lived during the 400's and 300's B.C. Hippocrates proposed that all diseases resulted from an imbalance of four *humors* (body fluids)—black bile, blood, phlegm, and yellow bile. The theory led to bloodletting—the drawing of blood from a vein of a sick person so the disease would flow out with the blood. For many centuries, bloodletting was standard medical treatment. Barbers performed the procedure during the Middle Ages. In the late 1700's and early 1800's, a number of doctors, especially the American physician Benjamin Rush, prescribed bloodletting to treat most illnesses. Some patients died of excessive blood loss.

In 1628, the English physician William Harvey described how blood circulates through the body. His work became the basis for later discoveries about the functions of blood. See **Harvey, William.**

In 1882, Élie Metchnikoff, a Russian biologist, discovered phagocytosis. His work helped explain how white blood cells kill germs. Also in 1882, an Italian biologist, Giulio Bizzozero, was the first person to correctly describe the function of platelets and relate them to blood clotting.

As knowledge of blood components increased, interest in transfusions grew. Physicians first transfused blood directly from donors into patients. Most of the attempts failed. Then in the early 1900's, Karl Landsteiner, an Austrian-born American physician, discovered the ABO blood types. Cross-matching blood types of donors and patients led to a dramatic increase in successful transfusions. In 1940, Landsteiner and Alexander S. Wiener, an American scientist, discovered the Rh factor.

The storage of blood became possible in 1914 with the addition of nutrients and of chemicals that checked clotting. In 1937, Bernard Fantus, an American physician, set up the first blood-bank program. Another American physician, Charles Drew, organized many such programs during World War II (1939-1945). Drew also urged the use of plasma, which at that time could be stored longer than whole blood, for battlefield and other emergency transfusions.

Scientists today are working to develop blood substitutes or artificial blood that could replace human blood in transfusions. Such research is important because, even with strict precautions, transfusions involve risk of reactions and the transmission of viruses and other infections through transfused blood.

Other current research involves producing and testing the hematopoietic growth factors responsible for the formation of all blood cells. Many of the growth factors are available in large amounts for use in patients. They are being used in patients who lack enough red or white blood cells or platelets. G. David Roodman

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Spleen
Stem cell
Temperature, Body
Triglyceride

Outline

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- B. Red blood cells
- C. White blood cells
- D. Platelets

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- A. Carrying oxygen and carbon dioxide
- B. Transporting nutrients and wastes
- C. Protecting against disease
- D. Carrying hormones
- E. Distributing body heat

III. How the body maintains its blood supply
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- B. Controlling bleeding
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VII. History of blood research

Questions

What does a *hematocrit* measure?
How does blood deliver oxygen to body cells?
Why do hospitals cross-match the patient's and donor's red blood cells before performing a transfusion?
How much blood does an 80-pound (36-kilogram) child have?
How do the ABO blood types differ from one another?
What is *leukemia? Hemophilia? Anemia?*
How does blood help keep body temperature steady and safe?
Where in the body do all blood cells begin?
What is *phagocytosis?*
How does blood circulate through the body?

Additional resources

Dailey, John F. *Blood.* Medical Consulting Group, 1998.
Parker, Steve. *Blood.* Copper Beech, 1997. Younger readers.
Starr, Douglas P. *Blood.* Knopf, 1998.

Blood bank. See Blood transfusion; Red Cross (Biomedical services).

Blood count is a test to determine the number of red and white cells and the amount of hemoglobin in the blood. A laboratory technician usually obtains blood for the test by pricking a person's finger or by taking blood from a vein with a needle. The technician mixes the blood with a solution to keep it from clotting. Then a drop of this mixture is placed on a piece of glass called a *counting chamber.* The technician uses a microscope to count the number of blood cells in the sample. This count also may be taken with an electronic counter. On another piece of glass, the technician spreads a thin film of blood and stains it. Using a microscope, the technician determines the percentage of different types of white blood cells on this glass. Too many white cells may indicate an infection. Too few cells may mean the blood-forming bone marrow is damaged. The color and number of red cells may indicate anemia (see **Anemia**). See also **Hemoglobin.** Joseph V. Simone

Blood doping is the practice of increasing the number of red blood cells in the body to improve athletic performance. Red blood cells carry oxygen from the lungs to the muscles and other tissues of the body. Blood doping increases the body's oxygen-carrying capacity, allowing athletes to train and compete with improved endurance and less fatigue.

Blood doping is illegal in sports because it gives some individuals an unfair advantage. In addition, increasing the number of red blood cells thickens the blood, which can cause heart attacks or strokes, and possibly death. Since the late 1980's, the deaths of at least 18 cyclists have been linked to blood doping.

In the past, blood doping was done by transfusing extra red blood cells into the body. An athlete would remove 1 to 3 pints (0.5 to 1.5 liters) of his or her own blood several weeks or months before a major competition. In a laboratory, technicians separated the red blood cells and froze them for storage. The blood cells were reinfused a few days before the competition.

Today, a more common method of blood doping involves injecting synthetic forms of a substance called *erythropoietin (ih RIHTH roh POY uh tihn),* also known as EPO. EPO is a naturally occurring hormone that stimulates the body into producing extra red blood cells. Some athletes use EPO to increase their red blood cell count without a transfusion. The performance-enhancing effects of EPO can last for several weeks.

Blood doping is difficult to detect because the substances used are normally found within the human body. One detection method is to monitor an athlete's *hematocrit (HEHM uh toh kriht* or *HEE muh toh kriht),* the ratio of red blood cells to total blood volume in a sample. An unusually high hematocrit may indicate blood

doping. In August 2000, the International Olympic Committee (IOC) announced that a reliable method of testing for blood doping with EPO had been developed. This test involved analyzing both a blood sample and a urine sample from athletes.

The term *doping* is also used to describe the use, for the sole purpose of improving athletic performance, of any substance banned by the IOC. These substances, often called *ergogenic (ur guh JEHN ihk) aids,* include stimulants, such as amphetamines and caffeine; narcotics (painkillers); *anabolic* (muscle-building) agents, such as steroids; *diuretics* (substances that rid water from the body); and a variety of hormones, such as human growth hormone. Bonita L. Marks

See also **Drug abuse; Olympic Games** (Charges of steroid use).

Blood poisoning is a disease involving infectious bacteria or fungi in the bloodstream. The disease involves bacteria far more often than fungi. In some cases, an infection or abscess in the body discharges the organisms into the blood. In other cases, the organisms enter the bloodstream through contaminated needles or other improperly sterilized instruments. Blood poisoning can also result from an injury in which a sharp object breaks the skin and brings germs into the bloodstream. The medical term for the disease is *septicemia.*

The symptoms of blood poisoning include chills, fever, and weakness. In some cases, the blood fails to clot normally, causing a rash or bleeding. If bleeding is severe, it can result in death. The disease also can lead to such complications as brain abscess, which can produce fatal pressure on the brain, and endocarditis (infection of the lining or valves of the heart), which can cause heart failure.

Blood poisoning is extremely dangerous, but most patients recover completely if they receive proper treatment. The physician first identifies the infecting organism and determines whether the patient has a center of infection that produced it. Such an infected area is treated with antibiotics or drained surgically. The blood poisoning itself is treated by injecting large doses of antibiotics into the bloodstream. Dominick Sabatino

Blood pressure is the pressure that blood exerts against the walls of the arteries. The amount of pressure depends upon the strength and rate of the heart's contraction, the volume of blood in the circulatory system, and the elasticity of the arteries.

Blood pressure is measured with an instrument called a *sphygmomanometer.* This instrument consists of (1) a cuff or wide rubber band that can be filled with air; (2) a hollow rubber bulb, which pumps air into the cuff; and (3) a gauge, or a glass tube containing a column of mercury.

To take blood pressure, the cuff is wrapped around the patient's arm. A stethoscope is placed over the arteries of the arm just below the cuff. The pulsations of blood in the arteries can then be heard. Air is pumped into the cuff, causing it to press down on the arteries. This stops the flow of blood, and the sounds stop. Then air is slowly let out of the cuff. When the pressure of the cuff becomes less than the blood pressure, the blood flow returns. The pressure at which the flow of blood resumes is called the *systolic pressure.* It represents the blood pressure when the heart is contracting. This pressure is determined by reading the gauge or the scale on the mercury tube. As more air is let out of the cuff, the sounds become muffled. The pressure at this point is called the *diastolic pressure.* It represents the blood pressure while the heart is relaxing.

Measurements of blood pressure include two numbers, such as 120/80. The first number refers to systolic pressure, and the second number refers to diastolic pressure. Normal systolic blood pressure for adults is about 120 millimeters. Some doctors consider pressures over 140 millimeters to be high. They also consider diastolic pressures over 90 millimeters to be high. Other doctors believe a reading greater than 150/95 indicates high blood pressure.

Blood pressure usually rises with age because the arteries become less elastic and slow down the flow of blood. High blood pressure may cause heart failure, strokes, or kidney failure. Physicians call high blood pressure *essential hypertension* when its cause is unknown. In 1957, scientists *synthesized* (made chemically) a substance in the blood believed to cause high blood pressure. Researchers use this substance, called *angiotensin II,* to study causes of hypertension.

Low blood pressure is called *hypotension.* Generally, hypotension need not be treated. Dominick Sabatino

See also **Arteriosclerosis; Hypertension.**

Blood sugar. See **Glucose.**

Blood transfusion is the transfer of blood or blood components into a person's bloodstream. People who lose large amounts of blood in accidents or surgery often need blood transfusions. Others have them to increase an inadequate number of blood cells or to provide substances lacking in their blood. Transfusion is a safe, effective medical procedure that saves many lives.

Blood banks collect, store, and distribute the blood for transfusion. Donors provide the blood. Blood banks in the United States follow guidelines set by the Food and Drug Administration (FDA). The American Red Cross collects more than 6 million units of blood each year, about half the blood collected in the United States. One unit of blood contains 450 milliliters (15 ounces) of blood plus 63 milliliters (2 ounces) of a preservative solution. See **Red Cross** (The American Red Cross).

Blood contains red blood cells, white blood cells, and *platelets.* Red blood cells carry oxygen and remove carbon dioxide from the body's tissues. White blood cells fight infections. Platelets are tiny cells that help form blood clots, which control bleeding. A yellow-brown liquid called *plasma* surrounds the red blood cells, white blood cells, and platelets. Plasma contains hundreds of dissolved substances, including proteins that enable blood to clot and others that fight infections.

Most people need only some parts of blood in a transfusion. For example, in a disease called *hemophilia,* blood does not clot normally. A person with hemophilia can receive a transfusion of *clotting factors,* the plasma proteins that cause blood to clot. Another person can receive a transfusion of red blood cells from the same unit of blood.

How blood is collected. Donors must meet strict health requirements before giving blood. Blood banks test donors for normal blood pressure, body temperature, and pulse. Blood banks also ask donors about illness, foreign travel, or other factors that might indicate

unsafe blood. Donors must be at least 17 years old and weigh 110 pounds (50 kilograms). A person can usually donate a unit of blood every two months.

During collection, a health-care worker takes blood from a vein in the donor's arm. Some blood samples are sent to a laboratory for tests. The remaining blood is transferred to a bag that contains a preserving solution of citrate and nutrient sugar. A machine called a *blood cell separator* breaks up the blood into its parts.

Laboratory technicians classify the blood samples into one of four ABO types and as Rh positive or Rh negative (see **Blood** [Blood groups]). They then carefully label all parts of the same unit of blood. Technicians also test the blood samples for certain infections, including the AIDS virus and a liver infection called *hepatitis B.* If the samples carry such infections, all blood collected from the donor is discarded.

Large numbers of platelets can be obtained from a single donor by a technique called *plateletpheresis* (pronounced *PLAYT liht fuh REE sihs).* In plateletpheresis, a health-care worker places a needle in each arm of the donor. Blood from one needle flows to a blood cell separator, which removes the platelets. The remaining components return to the donor through the other needle. A person can donate platelets every 48 hours—up to 24 times in a year—because the body rapidly replaces them. Blood banks can store platelets for five days at room temperature.

Types of transfusion. Three important types of blood transfusions are (1) red blood cell (RBC) transfusion, (2) platelet transfusion, and (3) clotting factor transfusion. Some people also need transfusions of whole blood or white blood cells.

RBC transfusion is the most common type of transfusion. It helps people who lose large amounts of blood in accidents or surgery. Before an RBC transfusion, samples of the patient's and the donor's blood are mixed to check for a harmful reaction. This test is called a *crossmatch.* During the transfusion, a tube carries red blood cells to a vein in the patient's arm. A special filter in the tube removes clumps, which may be fatal if they reach the patient's body. Blood banks can refrigerate red blood cells for 35 to 42 days or freeze them for years.

People who lose large amounts of platelets because of infection or the action of certain drugs may need a platelet transfusion. Plateletpheresis makes it possible to obtain enough platelets for a transfusion from a single donor. The use of platelets from one donor reduces the chance of a harmful reaction to the transfused platelets.

A clotting factor transfusion is lifesaving for people whose blood does not clot normally. One source of clotting factors is frozen plasma. Blood banks freeze plasma soon after collection and thaw it before a transfusion. The solid substance that remains in the bag after thawing, called *cryoprecipitate,* contains the clotting factors. The clotting factors are injected into a vein in the patient's arm. Clotting factors can be obtained from frozen plasma for up to one year.

Risks of transfusion. There is little health risk involved in donating blood. However, possible complications for the recipient of a transfusion range from mild to serious. Mild complications might include a fever or an allergic reaction, such as a rash or wheezing. Serious complications might include dangerous illness or death. For example, an *acute hemolytic transfusion reaction* may occur if a patient mistakenly receives red blood cells of the wrong type. The patient's blood quickly destroys the red blood cells. The reaction may involve chills, fever, chest and back pain, abnormal bleeding, kidney failure, or even death.

Careful testing can prevent many serious complications from blood transfusions. Today, the risk of catching an infectious disease from a transfusion is small because blood is tested for many diseases. Since 1985, when laboratories began checking all donated blood for the HIV virus, AIDS cases from transfusions have dropped dramatically (see **AIDS** [Medical care for HIV infection and AIDS]; **Hemophilia** [Treatment]).

The risks of transfusions—which are small but serious—have caused scientists to search for safer options. Some people store their own blood in case they need a transfusion. Scientists are also investigating artificial blood substitutes, which would not be perishable or carry disease.

History. In 1667, the French physician Jean-Baptiste Denis performed the first known blood transfusion to human beings. He injected lamb's blood into three patients, but one died soon after. Interest in blood transfusion declined until 1829, when the British obstetrician James Blundell successfully used transfusions on women in childbirth. The discovery of blood types in the early 1900's by the Austrian-American immunologist Karl Landsteiner increased the safety of transfusion. After World War II (1939-1945), transfusion became a common treatment for illnesses and medical emergencies.

The American Association of Blood Banks is an association of hospital and community blood banks and their personnel. In addition to inspecting and accrediting blood banks, they publish informational material on blood banking, blood transfusion, and careers in blood banking. The association has headquarters in Bethesda, Maryland. G. David Roodman

See also **Anticoagulant; Blood; Plasma; Rh factor.**

Bloodhound is a breed of dog that has a keen sense of smell. In spite of its name, the bloodhound is not vicious and has no special fondness for blood. A better name for this dog would be blooded hound, because of its early records of pedigree in Europe.

This hound's sensitive nose enables it to detect foot scent on the ground and body scent brushed off on bushes. Trained bloodhounds usually can follow a trail that is several hours old. Some can follow older trails if the scent is not destroyed by rain or other scents.

Bloodhounds weigh from 80 to 110 pounds (36 to 50 kilograms). They have black and tan, red and tan, or tawny coats; long, droopy ears; and a wrinkled face.

Critically reviewed by the American Bloodhound Club

See also **Dog** (picture: Hounds); **Hound.**

Bloodletting is the process of drawing blood from the body in the treatment of disease. Polycythemia is one of the few diseases in modern times that is treated by bloodletting. In this disease, the blood cells grow too rapidly. The blood becomes thick and sluggish. Bloodletting removes the excess amount of blood. It is usually done by drawing blood from a vein. In early times, barbers often performed bloodletting. Usually, it only weakened the patient. Bloodletting is also known as venesection and phlebotomy. Dominick Sabatino

Bruce Coleman Inc.

The bloodroot has a single blossom on each stalk.

Bloodroot, also called *red puccoon,* is a flower that grows in Canada and the United States. It blooms in early spring. The plant's leaves are kidney-shaped and deeply lobed. Each of the bloodroot's stalks has one white or rose-tinted blossom. The plant contains a deep orange-red sap.

The bloodroot has been used in medicine to shrink swollen tissues. It contains tannin, a substance used in tanning leather. Indians once used the sap of the bloodroot as war paint. Today, the sap is used in toothpaste to help prevent plaque and to treat gum disease.

Scientific classification. The bloodroot belongs to the poppy family, Papaveraceae. Its scientific name is *Sanguinaria canadensis.* J. Massey

See also **Flower** (picture: Flowers of woodlands and forests).

Bloomer, Amelia Jenks (1818-1894), a temperance reformer and advocate of women's rights, became famous in 1851 for her "Turkish pantaloons," called bloomers. She wore them with a skirt reaching below the knees. She was not the first to wear bloomers, but her journal, the *Lily,* advocated their use and called attention to her. She wore bloomers when she lectured and always drew crowds. She stopped wearing them in 1859.

She was born in Homer, Cortland County, N.Y. She married a newspaper editor, Dexter C. Bloomer, of Seneca Falls, N.Y., in 1840. The *Lily,* begun as a temperance paper in 1849, contained news of other reforms as well. Mrs. Bloomer also became deputy postmaster of the town in 1849. She said that she wanted to give "a practical demonstration of woman's right to fill any place for which she had capacity."

N.Y. State Library

Amelia Bloomer was a champion of women's rights.

Bloomer and her family moved to Ohio in 1854, then settled in Council Bluffs, Iowa. As a suffragist, she continued writing and lecturing in favor of women's rights.

Louis Filler

Bloomfield, Leonard (1887-1949), was a leading American linguist who developed scientific methods for the study of language. He helped establish the school of linguistics called *structuralism* (see **Linguistics** [Structuralism]). Structuralists study language forms and patterns without reference to meaning or content.

Bloomfield worked mainly with Germanic, Polynesian, and American Indian languages and devised a system for describing language structures. His book *Language* (1933) became the major text of the American structural school of linguistics and a classic in its field. Bloomfield also contributed to the practical teaching of reading and foreign languages.

Bloomfield was born in Chicago. He graduated from Harvard University and received a Ph.D. from the University of Chicago. He taught linguistics at the University of Chicago and Yale University. Bloomfield helped found the Linguistic Society of America in 1924 and later served as its president. Marianne Cooley

Bloomsbury Group was an informal association of English intellectuals, most of them educated at Cambridge University. They met frequently from about 1906 to 1930 in the houses of Virginia Stephen, her sister Vanessa, and her brother Adrian. Their homes were in a section of London called Bloomsbury. Virginia Stephen gained fame as the novelist Virginia Woolf after her marriage in 1912 to Leonard Woolf, a member of the group.

The Bloomsbury Group included the art critics Clive Bell and Roger Fry, the painter Duncan Grant, the author E. M. Forster, the economist John Maynard Keynes, and the biographer Lytton Strachey. Others who sometimes met with the group included the poet T. S. Eliot, the author Aldous Huxley, and the philosopher Bertrand Russell.

The group discussed and debated questions of art, morality, philosophy, and religion. The members had no single position on any issue but opposed what they felt was the conservatism of English society in matters of religion and morality. From an irreverent and agnostic perspective, they dedicated themselves to seeking truth through the use of reason. Garrett Stewart

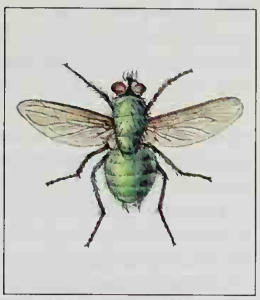
See also **Woolf, Virginia; Strachey, Lytton.**

Blount, *bluhnt,* **William** (1749-1800), was a North Carolina signer of the Constitution of the United States. At the Constitutional Convention of 1787, Blount took no part in debates. But his support of the Constitution helped win *ratification* (approval) for the document in his state.

Blount was born near what is now Windsor, N.C. In 1776, he entered the Revolutionary War in America and soon became a paymaster to North Carolina troops. Blount was elected to the North Carolina legislature in 1780 and served until 1789. He also served in the Congress of the Confederation in 1782 and 1783 and again in 1786 and 1787.

In 1790, President George Washington appointed Blount the first territorial governor of Tennessee. When Tennessee became a state in 1796, he was elected one of its first two U.S. senators. But the Senate expelled Blount in 1797, after discovering that, while a senator, he had plotted to help British troops and local Indians attack the Spanish territories of Florida and Louisiana. The U.S. House of Representatives began impeachment proceedings, but the case was dismissed due to lack of jurisdiction. Blount's case established that Congress would discipline its own members rather than use impeachment. Blount served in the Tennessee Senate from 1798 until his death. Joan R. Gundersen

Blow fly is the name of several kinds of flies. Many have bodies colored a metallic blue or green. Because of their appearance, some of these flies are called *bluebottles* or *greenbottles*. Some blow flies are the size of the house fly, and others are three or four times larger. Their eggs are laid in meat, in the bodies of dead animals, or in wounds of living ones. Dead meat or living tissue in which the eggs have been laid is said to be *flyblown*. The eggs quickly hatch into wormlike maggots which tunnel through the flesh. Blow fly maggots may cause disease in people and animals. They should be kept out of houses, and great care should be used to keep all food out of their reach. Garbage cans should be tightly covered, because blow flies breed in them. These flies may produce thousands of offspring in a few days.



WORLD BOOK illustration by Shirley Hooper, Oxford Illustrators Limited

Blow fly

Some blow fly maggots, such as screwworms and wool maggots, eat the body tissue of living animals. The eggs are laid in open sores in the hides of livestock. The infestation of fly maggots in the flesh of live animals is called *myiasis*. When they feed in large numbers, blow fly maggots may cause death to farm animals. One method of controlling these flies is to sterilize male flies by radiation. Females that mate with these males lay eggs that will not develop.

Blow flies do good as well as harm. They dispose of the bodies of dead animals that would otherwise take a long time to decay. Some blow flies pollinate plants.

Scientific classification. Blow flies belong to the blow fly family, Calliphoridae, of the true fly order, Diptera. Bluebottles are genus *Calliphora*. Screwworm flies are genus *Cochliomyia*.

Sandra J. Glover

Blowgun is a tube through which pellets or thin darts are blown by a quick puff of air from the lungs. Blowguns are more accurately called *blowpipes*. They range in length from about 4 feet to 9 feet (1.2 to 2.7 meters) and are generally made of reeds of grass, bamboo, wood, or metal. They are silent and thus well-suited for hunting birds and other small game in forests.

Blowpipes have been used for hunting in most parts of the world, but they were used in warfare only in Borneo and other islands in Indonesia. Warriors there found blowpipes useful against enemy tribesmen. Darts from these weapons, however, often failed to penetrate the thick clothing worn by European colonists. As a result, the blowpipe was used less and less in war. Today, some British veterinarians use blowpipes to shoot darts dipped in drugs for calming animals with rabies.

Walter J. Karcheski, Jr.

See also Jívaro Indians (picture).

Blubber is a thick layer of fat that lies under the skin and over the muscles of whales, dolphins, porpoises, seals, sea cows, and other sea mammals. It protects the animals from cold.

Whale oil is obtained by heating the blubber of the whale. The oil was once commonly used in such products as cosmetics, crayons, glue, margarine, and soap. Eskimos eat blubber. See Whale (Skin and blubber; Processing whale products). John K. B. Ford

Blücher, *BLOO kuhr,* **Gebhard Leberecht von,** *GEHP hahrt LAY buh rehkht fuhn* (1742-1819), was the Prussian marshal whose arrival with reinforcements helped the British defeat Napoleon's army at the Battle of Waterloo (see Waterloo, Battle of). Throughout the day of June 18, 1815, the French attacked the British. The Duke of Wellington, knowing that his soldiers could not hold out much longer, anxiously hoped for "Blücher or night." The aged Blücher finally arrived, and Napoleon was defeated.

Blücher also helped defeat Napoleon at Leipzig in 1813 and helped capture Paris in 1814. He became general field marshal and Prince of Wahlstatt. The people named him *Marshal Forward*.

Blücher was born in Rostock, Germany. As a youth, he joined first the Swedish Army and then the Prussian Army. Blücher retired as the most highly decorated marshal in the Prussian Army. Otis C. Mitchell

Blue. See Color.

Blue baby is a term used to describe a newborn infant whose skin appears blue. The condition of having bluish skin is called *cyanosis*. It occurs when the blood contains a less than normal amount of oxygen. Although many disorders can cause cyanosis, a blue baby has this condition because of an abnormality of the heart. Abnormalities that cause cyanosis in babies include defective heart valves, holes between the chambers of the heart, heart chambers that are too small to circulate blood properly, and defects or blockages in the blood vessels that connect with the heart.

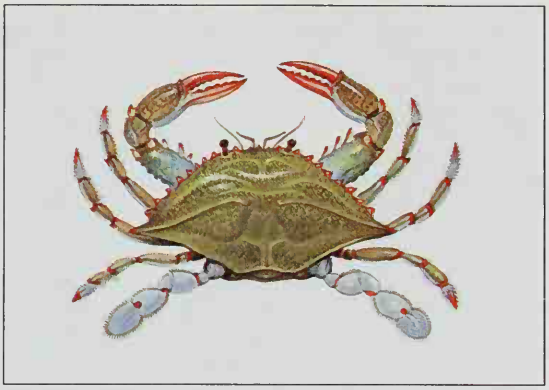
Normally, blood that contains carbon dioxide returns from the body to the right side of the heart. It is then sent to the lungs, where oxygen replaces the carbon dioxide. This oxygenated blood returns from the lungs to the left side of the heart and is pumped to all parts of the body. But in a blue baby, the defective heart allows some unoxygenated blood to be pumped through the body. Thus, the baby's blood has a lower-than-normal oxygen content, and the skin takes on a bluish color.

Most blue babies need heart surgery to correct their condition. Some recover with the use of medication. About 80 per cent of all blue babies recover fully.

Gerald B. Merenstein

See also Cyanosis; Heart (Blockage of the blood flow); Taussig, Helen B.

Blue crab is a highly valued food crab that lives in shallow waters along the Atlantic coast of the United States. The crab's greenish-brown shell measures about



WORLD BOOK illustration by James Teason

The blue crab gets its name from its blue legs. The crab has a greenish-brown shell and powerful claws with red tips.

6 inches (15 centimeters) wide and 3 inches (8 centimeters) long. The legs and body are blue, and the tips of the legs and claws are reddish. The blue crab is a good swimmer. After *molting* (shedding) its shell and before the new shell hardens, the crab is known as a *soft-shelled crab.* At this stage, the whole crab may be cooked and eaten. Jonathan Green

Scientific classification. The blue crab belongs to the family Portunidae in the subphylum Crustacea, order Decapoda. Its scientific name is *Callinectes sapidus.*

See also Crab.

Blue Cross and Blue Shield are the names and symbols used by about 70 local, nonprofit organizations in the United States that finance health care insurance coverage. These organizations are called *Blue Cross and Blue Shield plans.* Subscribers to a Blue Cross and Blue Shield plan make regular payments to the plan. In turn, the plan pays part or all of the subscriber's hospital and doctor bills. Blue Cross and Blue Shield plans also may cover certain other medical expenses, such as charges for dental and vision care, or for health care at home.

About 74 million people subscribe to Blue Cross and Blue Shield plans. Another 5 million people subscribe to associated plans in Canada and Jamaica. The activities of the local plans are coordinated and assisted by the Blue Cross and Blue Shield Association. The association has headquarters in Chicago.

Critically reviewed by the Blue Cross and Blue Shield Association

See also **Medicine** (Providing medical care).

Blue jay is a common bird of the eastern half of the United States and Canada. It has blue and white plumage and a crested head. The blue jay is a relative of crows and magpies. Like those birds, it is large, bold, and has a loud, harsh voice.

The blue jay is nearly 1 foot (30 centimeters) long, including the tail. Its belly and chin are light gray. There is a collar of black feathers across its throat and on the sides of its head. The blue jay can raise or lower the crest on its head. This crest is gray-blue with a purplish tint. The same color is in the feathers on the bird's back. The feathers on the blue jay's wings and tail are a brighter blue, with white bands and black crossbars.

During nesting season, the blue jay takes the eggs and young from nests of other birds. But most of its food consists of nuts and smaller seeds. It also eats many harmful insects. Blue jays build loose, untidy nests in trees or shrubs. They lay from three to six eggs, which are blue, green, or yellow with spots of brown or gray. They live about four to six years. Donald F. Bruning

Scientific classification. The blue jay belongs to the crow family, Corvidae. It is *Cyanocitta cristata.*

E. R. Degginger

Blue jay

See also **Bird** (pictures: Birds of urban areas; Birds' eggs); **Jay.**

Blue laws were the first printed laws of New Haven Colony in Connecticut. They may have been given the name because they were bound in blue or printed on blue paper. Today the term *blue laws* refers to laws designed to enforce morality as some lawmakers understand it, such as laws prohibiting certain types of recreation on Sunday.

The early blue laws of New Haven Colony were widely publicized by Samuel Peters (1735-1826) in his colorful, but highly inaccurate, book *A General History of Connecticut,* first published in London in 1781. Some laws such as Peters described existed, but they were probably never strictly enforced. Other laws mentioned in the book merely reflect Peters's vivid imagination.

Some of the most famous of the 45 laws that Peters listed are the following:

No food or lodging shall be afforded to a Quaker, Adamite, or other Heretic.

No Priest shall abide in this Dominion: he shall be banished, and suffer death on his return.

No one shall travel, cook victuals, make beds, sweep house, cut hair, or shave, on the Sabbath day.

Whoever brings cards or dice into this Dominion shall pay a fine of 5£.

No one shall read Common-Prayer, keep Christmas or Saints-days, make minced pies, dance, play cards, or play on any instrument of music, except the drum, trumpet, and jewsharp. John W. Ifkovic

Blue moon is a folklore term that has many definitions. As early as 1528, this term was used to represent an absurd belief. Later, people described uncommon events as occurring "once in a blue moon." Additional definitions of blue moon refer to rare types of full moons.

Two types of full moons qualify as blue moons. According to one definition, a blue moon is the second full moon in a month that has two full moons. According to an older definition, a blue moon is the third full moon in a season that has four full moons. The older definition was developed using a calendar in which spring always begins on March 21. In this calendar, the beginnings of summer, autumn, and winter are based on the position of an imaginary sun called the *dynamical mean sun.* Today, astronomers use a different rule for determining the beginnings of the seasons, as explained in the *World Book* article **Season.**

In the early 1900's, the *Maine Farmers' Almanac* published dates on which blue moons would appear, using

Dates of blue moons*

Year	Date	Year	Date	Year	Date
2002	Nov. 20	**2019**	Feb. 19	**2035**	May 22
2005	Aug. 19	**2021**	Nov. 19	**2038**	Feb. 19
2008	May 20	**2024**	Aug. 19	**2040**	Nov. 18
2010	Nov. 21	**2027**	May 20	**2043**	Aug. 20
2013	Aug. 21	**2029**	Nov. 21	**2046**	May 20
2016	May 21	**2032**	Aug. 21	**2048**	Nov. 20

*Determined by the older definition mentioned in the text of this article. Dates are for the Greenwich Meridian, the north-south line designated as 0° longitude. This line passes through Greenwich, a borough of London. Dates in other parts of the world can be one day earlier or one day later.

the older definition. The newer definition of the second full moon in a month originated in *Sky & Telescope* magazine in 1946. Other publications adopted the definition, and many people came to accept it. In 1999, however, *Sky & Telescope* published an article explaining that the 1946 definition actually originated from a misreading of the *Maine Farmers' Almanac.* Donald W. Olson

Blue Ridge Mountains are eastern ranges of the Appalachian Mountain System. The mountains extend from southeastern Pennsylvania across Maryland, Virginia, North Carolina, South Carolina, and northern Georgia. The mountains are named for the blue tone that the forested slopes have when seen at a distance.

In Virginia, the Blue Ridge Mountains are 12 to 14 miles (19 to 23 kilometers) wide, and separate the Piedmont Region from the Great Valley or Valley of Virginia. In North Carolina, the Blue Ridge forms the eastern section of a mountain chain over 75 miles (121 kilometers) wide. Other parts of this chain include the Black Mountains and the Great Smokies.

The highest peaks of the Blue Ridge Mountains are in North Carolina. Mount Mitchell, the tallest peak, rises 6,684 feet (2,037 meters) above sea level. The James, Potomac, and other rivers have cut narrow, picturesque valleys through these mountains. The Blue Ridge Mountains are famous for their beautiful scenery, especially along the Skyline Drive in Virginia. The Blue Ridge Parkway extends about 500 miles (800 kilometers) south of the Skyline Drive. Michael P. O'Neill

Related articles in *World Book* include:

Great Smoky Mountains
North Carolina (pictures)
Piedmont Region
Shenandoah National Park
South Carolina (picture)
Virginia (pictures)

Blue-sky laws are state laws that regulate the sale of bonds, stocks, and other securities. The promoters must disclose all the interest they are keeping for themselves, and just what, besides "blue sky," they have contributed in return. Blue-sky laws are not so important now as they once were. The federal Securities Act of 1933 placed federal control over securities sold in more than one state. Robert Sobel

Blue thistle. See Viper's bugloss.

Blue whale is the largest animal that ever lived. The blue whale reaches up to 100 feet (30 meters) long and can weigh over 150 tons (135 metric tons). It has speckled blue-gray and white skin, relatively small, thin flippers, and a large, strong tail.

The blue whale strains food from the water using 260 to 400 thin, fringed plates called *baleen,* hanging from each side of its mouth. The whale eats primarily *krill,* a shrimplike animal. It lunges through masses of krill, taking in tons of water and food. It then closes its mouth and squirts the water out through the baleen, trapping the krill inside.

Blue whales usually dive no deeper than about 300 feet (90 meters) because krill tend to live at shallow depths. The whales surface to breathe three to six times in rapid succession, then dive for several minutes. When surfacing, they exhale sharply through their *blowholes* (nostrils), producing a loud sound.

Blue whales live in all the oceans. They feed in waters in or near the polar regions, and usually travel in groups of two or more. Two whales often work together while feeding, apparently using each other's bodies as walls to help trap prey. Blue whales migrate to waters closer to the equator to breed. They make loud, low moans that can travel great distances through the water. Scientists think the moans allow whales to communicate within an area of at least 100 square miles (260 square kilometers).

During the early and mid-1900's, blue whales were hunted nearly to extinction. But their numbers have steadily increased since the 1960's, when many countries agreed to stop or severely limit the hunting of blue whales. In the early 1990's, an estimated 10,000 to 15,000 blue whales survived. Bernd Würsig

Scientific classification. The blue whale belongs to the suborder Mysticeti, order Cetacea. Its scientific name is *Balaenoptera musculus.*

See also **Whale** (picture); **Animal** (picture: The huge blue whale).

Bluebell is the name given to several plants with blue flowers shaped like bells. The *bluebell of Scotland,* sometimes called *hairbell* or *harebell,* is found in Europe, Asia, and North America. It grows in meadows and on mountain slopes. The *Virginia bluebell,* also called the *Virginia cowslip,* is native to North America. It is one of the most beautiful spring wildflowers. Its blossoms grow on leafy stems that are 12 to 15 inches (30 to 38 centimeters) high. It often grows in low wet areas near rivers or on moist hillsides.

Bluebells are often used as border plants because

Grant Heilman

The bluebell's flowers resemble tiny bells.

their strong, slender stems can withstand rough winds. The blossoms hang downward and protect the pollen from rain and insects. The lower leaves are broad. Those on the stem are long and slender. James S. Miller

Scientific classification. Bluebells belong to either the bellflower family, Campanulaceae, or the borage family, Boraginaceae. The bluebell of Scotland is *Campanula rotundifolia*. The Virginia bluebell is *Mertensia virginica*.

See also **Flower** (picture: Flowers of the desert).

Blueberry is a small, sweet fruit that grows on a shrub of the same name. People eat blueberries fresh or cook them in such foods as blueberry pie and preserves. Ripe blueberries range in color from light blue to black and have a waxy, powdery-gray coating. They measure from $\frac{1}{8}$ inch to more than 1 inch (0.3 to more than 2.5 centimeters) in diameter. Blueberry bushes have green leaves and bear white or pink flowers.

Blueberries grow wild in many parts of the world.

WORLD BOOK illustration by Allianora Rosse

Blueberries grow in clusters from the flowers on blueberry shrubs. The fruit ranges in color from light blue to black.

However, the United States and Canada supply about 95 percent of the blueberries used by the food industry. North American farmers harvest about 103 million pounds (47 million kilograms) of blueberries annually. Nearly a third of the crop is sold as fresh fruit, and another third is frozen. The rest is canned or goes into bakery goods, ice cream, and other food products.

The food industry uses two main kinds of blueberries, *lowbush* and *highbush*. Lowbush blueberry shrubs grow wild and are about 6 to 18 inches (15 to 46 centimeters) tall. Farmers sell them for use in canned and other processed foods. Most lowbush blueberries are supplied by Maine and the Canadian provinces of New Brunswick, Newfoundland and Labrador, Nova Scotia, Prince Edward Island, and Quebec.

Highbush blueberries make up most of the fresh blueberries sold in groceries. Farmers plant and cultivate the bushes, which reach a height of 3 to 6 feet (0.9 to 1.8 meters). Most highbush blueberries come from Arkansas, Michigan, New Jersey, North Carolina, Oregon, Washington, and British Columbia. The *southern highbush* is grown in Florida. It is a hybrid developed by crossing the common *highbush blueberry* and a native Southern variety.

The *rabbit-eye blueberry* is grown by farmers in some Southern States. This hardy species is the tallest blueberry plant and may reach 15 feet (4.6 meters).

All blueberries grow best in acid soil. To blossom normally, they need a cold, inactive period during the winter. However, most blueberry plants cannot survive temperatures below −20°F (−29°C). A healthy plant can produce as many as 20 pints (9 liters) of berries annually and may live longer than 50 years.

The fresh blueberry season lasts from May through June in the South and from June through September in the North. About 60 percent of the blueberry crop is picked by hand, but many farmers pick highbush and rabbit-eye blueberries with large harvesting machines. The berries are cleaned, packed in boxes, and shipped to stores. Lowbush blueberries are sent to processing plants to be canned or frozen. Paul Eck

Scientific classification. Blueberries belong to the heath family, Ericaceae. An important highbush species is *Vaccinium corymbosum*. The southern highbush is a hybrid of *V. corymbosum* and *V. darrowi*. The rabbit-eye species is *V. ashei*. Important lowbush species include *V. angustifolium*, *V. lamarkii*, and *V. myrtilloides*.

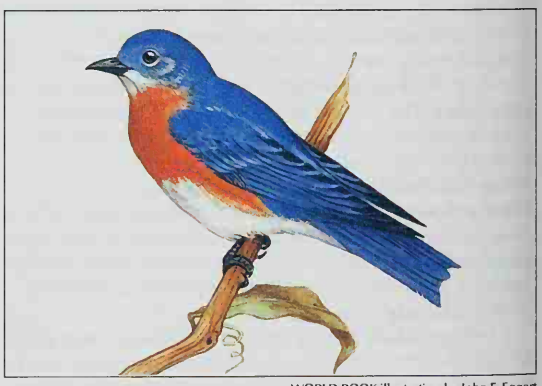
Bluebird is any of three species of North American songbirds known for their brilliant, blue feathers. Each species has its own characteristic shades of blue, though this shade varies with light conditions. All three species measure about 6 to 7 inches (15 to 18 centimeters) long and have black beaks and legs.

The *eastern bluebird* is found east of the Rocky Mountains from southern Canada to northern Nicaragua. The adult male has deep blue feathers on the head, back, tail, and wings. The breast and throat are chestnut-colored and the belly is white. The female resembles the male but has duller plumage.

The *western bluebird* resembles the eastern bluebird, except that it has a blue throat and a chestnut-colored upper back. The western bluebird ranges from southern British Columbia to south-central Mexico.

The *mountain bluebird* lives in the mountains of western North America from central Alaska to northern Mexico. The adult male is deep sky-blue with a paler throat and breast, and a white belly. The female is brownish with pale blue wings and tail.

The life of bluebirds. Bluebirds eat a variety of insects, including grasshoppers, beetles, flies, and espe-



WORLD BOOK illustration by John F. Eggert

The eastern bluebird has deep blue feathers.

cially caterpillars. In winter, bluebirds also eat berries. Bluebirds use several techniques to hunt for food, including hovering over fields and searching from perches, such as fence posts and tree limbs. Eastern and western bluebirds mostly search from perches. Mountain bluebirds hover a great deal.

Bluebirds live in open forests, at forest edges, and in natural grasslands. They also live in pastures, orchards, and parks. Bluebirds build nests in protected spaces, such as old woodpecker holes and birdhouses. The nest is made of coarse grasses and lined with softer materials, such as feathers and fine grasses. The female bluebird does most of the nestbuilding.

The female lays three to seven pale blue or white eggs. The male brings food to the female while she sits on the eggs. The eggs hatch in about two weeks. The male provides most of the food when the young are small. The female stays in the nest to keep the young warm. Later, the male and female both feed the young. The young leave the nest two to three weeks after hatching. Young bluebirds have adult wing and tail color, making it possible to determine their sex while they are still in the nest.

After nesting, bluebirds gather in flocks. They migrate to southern parts of their ranges in the fall. By migration time, flocks may have as many as 200 individuals. However, flocks more often consist of fewer than two dozen birds. Most bluebirds live no more than 1 or 2 years in the wild, but some survive up to 10 years.

Bluebirds and people. The populations of all three bluebird species increased in the 1800's, then fell in the first half of the 1900's. This rise and fall in bluebird numbers resulted mainly from human activities that created and then eliminated large areas of open country, which bluebirds tend to inhabit. The introduction from Europe of house sparrows and starlings in the second half of the 1800's contributed to the drop in bluebirds in the 1900's. As sparrows and starlings expanded across North America, they competed with bluebirds for nesting sites. Since the 1960's, however, bluebird populations in many areas have risen, in part because amateur conservationists have built many bluebird houses. Eastern bluebirds especially have benefited from this conservation effort.

Scientific classification. Bluebirds are in the subfamily Turdinae of the family Muscicapidae. The scientific name for the eastern bluebird is *Sialia sialis;* the western bluebird is *S. mexicana;* and the mountain bluebird is *S. currucoides.*

Harry W. Power

Bluebonnet is the state flower of Texas. It is a wild prairie flower and belongs to the pea family. Bluebonnet plants are from 6 to 16 inches (15 to 41 centimeters) high. They have bright blue blossoms shaped like tiny bonnets. The blossoms have a white center. Bluebonnets cover the prairie in some parts of Texas, but they do not grow well in Northern States.

The bluebonnet is an annual plant. It blooms in the spring and is killed by frost the following fall. During the summer the bluebonnet drops seeds from which the next year's plants grow. The name *bluebonnet* has been given to other plants with blue blossoms. The *cornflower* is sometimes called *bluebonnet.*

Scientific classification. Texas bluebonnet is in the pea family, Fabaceae or Leguminosae. Its scientific name is *Lupinus subcarnosus.* The cornflower belongs to the family Asteraceae, also called Compositae. It is *Centaurea cyanus.* Roy E. Gereau

See also **Legume; Lupine; Texas** (picture: State flower).

Bluefish is a food fish that lives in the Atlantic Ocean from Nova Scotia to the southern tip of South America. Some also live in the Indian Ocean, the Mediterranean Sea, and the Pacific Ocean around Australia. Most bluefishes grow 15 to 24 inches (38 to 61 centimeters) long and weigh from 1 to 4 pounds (0.5 to 1.8 kilograms). But some bluefishes grow almost 4 feet (1.2 meters) long and weigh more than 30 pounds (14 kilograms).

The bluefish feeds on smaller fish. It is fierce and often kills more fish than it can eat. Bluefishes usually swim in *schools* (groups) that may extend for several miles. Their fine flavor makes them a profitable catch for the fishing industry. Bluefishes are also popular sport fishes because they fight fiercely when hooked.

© Tom McHugh, Photo Researchers

The bluefish gets its name from its bluish color. A ferocious fish, it uses its razor-sharp teeth to tear apart its prey.

Scientific classification. The bluefish makes up the family Pomatomidae. It is *Pomatomus saltatrix.* Tomio Iwamoto

Bluegill. See Sunfish.

Bluegrass is the name of approximately 200 kinds of grasses that grow in cool regions of the world. Bluegrasses have flat or folded blades with tips shaped like the bow of a boat. The most important type of bluegrass in the United States is Kentucky bluegrass. It is a *perennial,* which means it lives through the winter and does not need to be replanted each year. Kentucky bluegrass can reach 24 inches (61 centimeters) high. It grows best in cool weather and in well-drained soil that is not too acidic. Hot, dry periods make Kentucky bluegrass *dormant* (inactive) and cause it to turn brown if enough water is not supplied.

There are about 50 commercial types of Kentucky bluegrass. It is the most popular grass for lawns and golf courses in the northern United States. It forms a thick sod that is helpful in preventing soil loss. Farmers often use Kentucky bluegrass in pastures. It is nourishing for animals and can withstand frequent grazing and trampling by cattle, horses, and sheep.

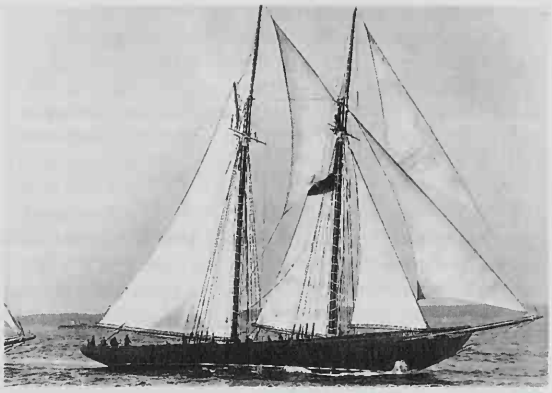
Early North American settlers brought Kentucky bluegrass from Europe and Asia. The grass got its name in the mid-1800's from the numerous bluegrass pastures found in Kentucky.

Scientific classification. Bluegrass belongs to the grass family, Poaceae or Gramineae. The scientific name for Kentucky bluegrass is *Poa pratensis.* Douglas A. Johnson

See also **Grass; Lawn.**

Bluegrass State. See Kentucky.

Bluenose was a Canadian fishing schooner that won five consecutive International Fisherman's races between Canada and the United States. The races won by



The Mariners' Museum, Newport News, Virginia

The *Bluenose* won all the International Fisherman's races between Canada and the United States from 1921 to 1938. The Canadian schooner was launched in 1921.

the *Bluenose* were held in 1921, 1922, 1923, 1931, and 1938. An image of the famous schooner appears on the Canadian dime.

The *Bluenose* was designed by William J. Roue of Halifax, Nova Scotia. It was launched at Lunenburg, Nova Scotia, on March 26, 1921. The schooner was used as a fishing vessel as well as for racing. Beginning in 1942, it was used to carry cargo in the Caribbean Sea. In 1946, the *Bluenose* ran aground on a coral reef near Haiti and sank.

The *Bluenose II,* an exact replica of the original schooner, was built in 1963. The *Bluenose II* is based in Lunenburg, Nova Scotia. Heather-Anne Getson

See also **Nova Scotia** (Visitor's guide).

Blueprint is a copy of the original drawing that shows how to construct a machine, a building, or another object. The original is called a *mechanical drawing.* Drafters use special photographic processes to make copies of a mechanical drawing. The copies are called blueprints because the oldest of these processes produces drawings with white lines on a blue background. Over the years, other photographic processes have been developed that create copies with dark lines on a white background. People use the term blueprint, however, to refer to any copy of a mechanical drawing, regardless of the color of the background.

Making a blueprint. To make a blueprint, the drafter must first make the original drawing on a material that allows light to pass through it, such as tracing paper, tracing cloth, or tracing film. The original drawing is then placed on top of light-sensitive paper and exposed to a bright light. The light passes through the tracing paper, but it does not pass through the lines made by the drafter.

In the traditional blueprint process, after the light-sensitive paper has been exposed to a bright light it is washed in water. The water causes the paper to turn blue wherever it has been exposed to light. The paper directly underneath the drafter's lines does not turn blue because the lines prevented the light from striking the paper. This process produces a copy that has white lines on a blue background.

Another process used to make copies of a mechanical drawing is called the *white print* process. In this process, after the light-sensitive paper has been exposed to a bright light it is developed by contact with ammonia fumes. The white print process creates copies that have dark blue, black, or red lines on a white background.

Using a blueprint. Blueprints are usually prepared by architects, engineers, designers, and drafters for the guidance of workers. The blueprint provides each worker with important information about the dimensions and position of each piece needed for a project. A machinist making a bumper, for example, will look at the blueprint of the bumper to determine the correct size of the piece of aluminum. A construction worker preparing to pour a concrete foundation will look at a blueprint to determine the proper thickness of the foundation. Both the machinist and the construction worker are reading the blueprint—that is, they are interpreting the views, the dimensions, and the lines and symbols in the drawing. This skill enables workers to understand the detailed instructions that are provided by the designers.

In the past, drafters had to make all mechanical drawings by hand. Today, however, many drafters use special computer programs to create mechanical drawings. As a result, traditional blueprints are no longer as widely used. A large number of designers now store their drawings in a computer and use a printer to produce copies. They can also transfer the drawings directly to other computers for viewing on a screen.

Frank M. Kelso and Donald R. Riley

See also **Mechanical drawing.**

Blues are a kind of music that developed in America from the various musical expressions of African Americans. The blues are an extremely flexible type of music, and various musicians have created individual styles of performing them. The blues contributed greatly to the development of jazz. Such jazz musicians as Duke Ellington, Charlie Parker, and Jack Teagarden have often included variations of the blues in their music. In addition, some classical music and numerous rock, folk, and country music compositions also show the influence of the blues.

The basic blues design is a 12-bar form that is divided into three sections of four bars each. Most blues lyrics consist of several three-line stanzas. The second line of each stanza repeats the first, and the third line expresses a response to the first two. Many blues lyrics reflect loneliness or sorrow, but others declare a humorous or defiant reaction to life's troubles.

Blues may have developed after the American Civil War (1861-1865) from short solo calls and wails called *field hollers.* Field hollers were used as a form of communication among black plantation workers in the South. In the late 1800's, country, or "down-home," blues developed in the Mississippi Delta region. These songs were sung by a male singer, usually with the accompaniment of a guitar. Blind Lemon Jefferson and Mississippi John Hurt were well-known singers of country blues.

The blues became more widely known in the early 1900's. A bandleader named W. C. Handy began to publish blues songs that won wide popularity. Handy's compositions include "Memphis Blues" (1912) and "St. Louis Blues" (1914). In the 1920's, Bessie Smith emerged as one of the most talented and popular of the classic blues singers. Recordings by Bessie Smith, Mamie Smith, Ethel Waters, and others helped bring urban blues to a

larger audience. In the 1930's, *boogie-woogie,* a blues-influenced style of piano music, became popular.

Valerie Woodring Goertzen

See also **Jazz** (The roots of jazz); **Handy, W. C.; King, B. B.; Waters, Muddy.**

Bluet is a small, elegant wild flower of eastern North America. The bluet plant sends up a tuft of delicate stems with narrow leaves that grow in pairs. The flowers have four petals and are pale blue, lilac, or white with a yellow center. The bluet has other common names, including *innocence* and *quaker-ladies.* J. Massey

Scientific classification. The bluet is a member of the madder family, Rubiaceae. Its scientific name is *Hedyotis caerulea.*

Bluford, *BLOO furd,* **Guion Stewart,** *GY uhn,* **Jr.** (1942-), a United States astronaut, became the first African American to travel in space. On Aug. 30, 1983, Bluford and four other astronauts began a six-day flight on the space shuttle Challenger.

During the flight, Bluford launched a communications and weather satellite for India, and he assisted in testing the shuttle's *remote manipulator arm.* The astronauts used the arm to carry a massive weight from the cargo area into space and back again. Bluford also participated in medical tests designed to discover why many astronauts suffer from motion sickness.

NASA

Guion S. Bluford, Jr.

In 1985, Bluford served with the West German Spacelab mission. He continued to serve on space shuttle flights until 1993, when he resigned from NASA and retired from the Air Force. That year, he became an executive at a computer and engineering company.

Bluford was born in Philadelphia. He joined the Air Force in 1964. He received a Ph.D. in aerospace engineering from the Air Force Institute of Technology in 1978 and then became an astronaut candidate. Lillian D. Kozloski

Blume, Judy (1938-), is an American author of humorous, realistic books for children and adults. She is best known for her novels about middle-class children, which discuss problems of young people from their point of view and in their own language.

The antics of a younger brother nicknamed Fudge in *Tales of a Fourth Grade Nothing* (1972), *Superfudge* (1980), and *Fudge-A-Mania* (1990) are popular with younger children. For an older age group, *Are You There, God? It's Me, Margaret* (1970) describes 11-year-old Margaret's reactions to her parents' mixed-faith marriage and to her own maturing body. In *Then Again, Maybe I Won't* (1971), a boy faces similar adolescent problems. *Tiger Eyes* (1981) focuses on the pain of losing a parent through death. *As Long As We're Together* (1987) tells about three girls and how one of them deals with her parents' divorce. Blume wrote about the same three girls in *Here's to You, Rachel Robinson* (1993).

Blume's books are often criticized for their subject matter and frank language. The novel *Deenie* (1973) stirred controversy because of a passage in which the girls' gym teacher explains masturbation. *Forever ...* (1975), which describes the first sexual experience of two high school students, has also aroused controversy. Defenders of Blume's books praise her ability to write openly and sympathetically about the concerns of young people in an enjoyable and easy-to-read style.

Letters from young readers and Blume's comments on them were collected in *Letters to Judy* (1986). Blume has written two novels for adults—*Wifey* (1978) and *Smart Women* (1983). She was born in Elizabeth, New Jersey.

Celia Catlett Anderson

Blunderbuss was a type of gun used primarily in Europe from the 1600's to the 1800's. A typical blunderbuss had a bell-shaped muzzle and was about 25 to 34 inches (64 to 86 centimeters) long. It mainly fired buckshot, which was loaded into the muzzle. The gun was deadly at close range against crowds or when used in cramped areas. It was a popular weapon with travelers, guards, and people defending coaches against robbers. The word *blunderbuss* probably comes from a German word meaning *thunder-gun.* Walter J. Karcheski, Jr.

Roger Roland Fuhr, ROLANDesign, Los Angeles

The blunderbuss was accurate only at close range. The gun was loaded through its bell-shaped muzzle.

See also **Harquebus; Musket.**

Bly, Nellie (1867?-1922), was the pen name of Elizabeth Cochrane Seaman, an American journalist famous for her daring exposés. She once pretended to be a thief and got arrested so she could learn how the police treated women prisoners. She also pretended to be insane to get inside a New York City mental hospital. Her report of cruelty to patients brought reforms.

Culver

Nellie Bly

In November 1889, Nellie Bly sailed from New York City on a trip around the world. Her newspaper, the *New York World,* sent her to outdo Phileas Fogg, the hero of Jules Verne's novel *Around the World in Eighty Days.* She made the trip—by ship, train, *jinrikisha* (handcart), and burro—in a record 72 days 6 hours 11 minutes.

Nellie Bly was born in Cochran's Mills, Pennsylvania, near Pittsburgh. Her real name was Elizabeth Cochran, but she added an *e* to her last name. She began her newspaper career at about the age of 18 after writing a letter to *The Pittsburgh Dispatch* in support of women's rights. The editor liked her writing and hired her as a reporter. She adopted her pen name from the song "Nelly Bly" by composer Stephen Foster. Miriam Schneir

Bly, Robert (1926-), is an American poet most widely known as a leader of the *men's movement.* This movement is a communal effort to rediscover the spiritual roots of maleness. Bly's prose work *Iron John: A Book About Men* (1990) is a key document in the movement. Bly analyzes flaws he sees in modern American society in another prose work, *The Sibling Society* (1996).

Long before the publication of *Iron John,* Bly was known for his quiet yet startling poems. His poems most often evoke intensely inward states of solitude, silence, and secrecy. Bly finds these qualities not only in people but also in landscapes—often Midwestern, winter landscapes. He also finds these qualities in animals, in plants, and even in inanimate objects. Bly has written beautiful love poems as well as fierce poems opposing the Vietnam War (1957-1975). However, all his poetry ultimately derives from a belief that both the self and nature are full of dark, mysterious depths where immense power dwells.

Bly was born in Madison, Minnesota. A good introduction to his work is *Selected Poems* (1986).

Roger Gilbert

B'nai B'rith, *buh NAY BRIHTH,* is the oldest and largest international Jewish service organization. Its Hebrew name means *Children of the Covenant.* B'nai B'rith was founded in 1843 for the purpose of "uniting Jews in their highest interests and those of humanity." The group has more than 500,000 members—men, women, and young people—in about 4,000 local units in 43 countries. B'nai B'rith Women, which is an organization within B'nai B'rith, has its own chapters for the 135,000 women members. The international headquarters of B'nai B'rith are in Washington, D.C.

The symbol of B'nai B'rith is the Menorah, or candlestick, with seven branches which stand for Light, Justice, Peace, Truth, Benevolence, Brotherly Love, and Harmony.

B'nai B'rith has volunteer programs in youth education and leadership, adult Jewish education, civic and veterans services, career guidance and vocational counseling, intergroup relations, and philanthropy. B'nai B'rith commissions supervise the organization's major service programs, which include:

The Anti-Defamation League of B'nai B'rith combats racial and religious prejudice and discrimination. It promotes harmony between racial and religious groups through educational programs. It has headquarters in New York City and maintains 30 regional offices in the United States. It also has offices in Jerusalem, Paris, and Rome.

B'nai B'rith Hillel Foundations maintain religious, cultural, and counseling centers at nearly 400 U.S. and Canadian universities, and at 30 universities in other countries. More than 200,000 Jewish students and faculty members participate in activities sponsored by Hillel Foundations.

B'nai B'rith Youth Organization directs the largest Jewish youth movement in the United States. The organization has about 35,000 members in about 1,400 chapters. It stresses cultural, educational, religious, service, and social activities for teen-agers. The movement is divided into two groups—Aleph Zadik Aleph for boys and B'nai B'rith Girls for girls.

Critically reviewed by B'nai B'rith

Boa is the name of a group of snakes that vary greatly in size. One kind of boa, the green anaconda, can reach more than 30 feet (9 meters) in length. Sand boas, on the other hand, may grow less than 3 feet (90 centimeters) long. Boas inhabit warm, usually tropical areas around the world.

Boas live on the ground, in trees, or occasionally in underground burrows. They eat live animals, such as small mammals and birds. Some kinds have sensory pits on their upper lips that detect heat. Boas use these pits to find prey in the dark. Many of the snakes kill prey by wrapping around the animal and squeezing it to death.

Female boas bear live young instead of laying eggs. The young are born covered with a thin membrane, from which they break free shortly after birth. Unlike other snakes, many boas have small remnants of hind legs called *spurs.*

The most common boa is the boa constrictor. It inhabits American tropical regions from Mexico to Argentina. Two species—rubber boas and rosy boas—live in the United States. These burrowing snakes hunt at night. They roll into a ball to protect themselves when frightened or threatened. Emerald tree boas live in South America. Their smooth scales are bright green with white spots. These snakes are almost invisible among the tree leaves, where they wait for prey to come near.

Albert F. Bennett

Scientific classification. Boas are members of the family Boidae. Sand boas make up the genus Eryx. The scientific name for the boa constrictor is *Boa constrictor,* and the green

© Giuseppe Mazza

The boa constrictor is the most common kind of boa. It lives in American tropical regions from Mexico to Argentina.

anaconda is *Eunectes murinas.* The emerald tree boa is *Corallus caninus;* the rosy boa, *Lichanura trivirgata;* and the rubber boa, *Carina bottae.*

See also **Anaconda; Boa constrictor;** Python; Snake (pictures; Classification of snakes).

Boa constrictor is a large snake that inhabits tropical parts of the Americas. It kills animals for food by squeezing them with its long body. It is not poisonous. Boa constrictors grow from 10 to 14 feet (3 to 4.3 meters) long. Most live in Brazil, French Guiana, Guyana, and Suriname.

Boa constrictors defend themselves as other snakes do, by *striking*—that is, by throwing their heads and the front part of their bodies at the enemy. Their teeth can make serious wounds because they point inward. Boa constrictors eat birds and rodents. When hunting for prey, the snakes lie still and attack animals that pass by them. They eat prey by swallowing it whole. Boa constrictors can swallow animals much larger than their heads because the bones of their jaws, throat, and body can stretch apart. Like other snakes, boa constrictors may live for many months without eating. They may become inactive for a week or more after a meal while they digest their food.

Female boa constrictors do not lay eggs. Their young are born alive. They may give birth to 50 young snakes at one time. Albert F. Bennett

Scientific classification. The boa constrictor belongs to the family Boidae. It is *Boa constrictor.*

See also **Boa; Snake** (picture: Some snakes of other continents).

Boabdil, *BOH ahb THEEL* (?-1533?), was the last king of Moorish Granada, now a province in southern Spain (see **Granada**). Granada was the last Moorish state in Europe. Boabdil ruled as Muhammad XII.

In the 1480's, Boabdil fought with his father (King Abu-l-Hasan Ali) and his father's brother al-Zagal for control of Granada. In 1487, Boabdil, aided by the Christian rulers of Castile and Aragon—King Ferdinand and Queen Isabella—occupied the capital, also called Granada. But Ferdinand and Isabella gradually took control of all of the kingdom except the capital. Finally, they besieged the capital and defeated Boabdil in 1492. Boabdil was given estates in Spain but moved to Morocco, where he died. James W. Brodman

Boadicea, *boh ad ih SEE uh* (?-A.D. 62), was queen of the Iceni, a tribe of Britons. She is also known as Boudicca (pronounced *boo DIHK uh*). Boadicea led the Iceni and other British tribes in a revolt against their Roman rulers. The British tribes burned London and other towns and defeated a Roman legion. Boadicea's husband, Prasutagus, had ruled as king of the tribe under the Romans. But Suetonius Paulinus, a Roman general and governor, decided to take over the Iceni territory after Prasutagus died. Boadicea, her daughters, and her tribespeople were robbed and treated unfairly.

Paulinus returned from Wales with most of his army and defeated the rebelling tribes in A.D. 60 and 61. Boadicea took poison to avoid capture. Conditions improved for the Britons after Emperor Nero learned they had revolted because of harsh treatment.

Mary Francis Gyles

Boar, Wild, is a wild hog of southwestern and central Asia and North Africa. Wild boars also once roamed the forests of Europe but now are rarely seen there in their free state. The name *boar* is also given to the male domestic hog. A wild boar does not usually grow so heavy and fat as a domestic hog. The wild boar stands 3 feet (90 centimeters) high or more at the shoulder. The wild animal may weigh as much as 400 pounds (180 kilograms). Wild boars are strong and ferocious.

The wild boar is colored grayish-black and has short hair and coarse bristles. The lower jaw has two powerful tusks that are used for fighting. The wild boar lives in dense thickets where it hides from danger. Sometimes it wallows in mud during the hot weather. It is a cautious animal and feeds at night on roots and grain. Sometimes the wild boar also eats small animals and birds' eggs. The boar's head was brought into the dining halls with great ceremony in ancient and medieval times.

Hunting the wild boar has been a favorite sport of kings and nobles from earliest times. When the Norman kings ruled England, anyone who killed a wild boar without royal permission might have his or her eyes put out. Some great estates in Europe still keep wild boars in their woods to hunt. Boars have also been brought to some parts of the United States to be hunted. Sports enthusiasts consider boar hunting on foot with hounds and spears exciting and dangerous. In India, the larger boar is hunted on horseback. The hunter carries a spear and kills the boar by charging it. This is called "pigsticking" in India. It is dangerous, but it is a favorite sport.

Duane A. Schlitter

Scientific classification. The wild boar is a member of the pig family, Suidae. It is *Sus scrofa.*

See also **Animal** (picture: Animals of the temperate forests); **Hog; Peccary.**

Board of health. See **Health, Board of.**

Board of supervisors. See **County** (Forms of county government).

Board of trade. See **Commodity exchange.**

Boas, Franz, *BOH az, frahnts* (1858-1942), a German-born American, was the most influential U.S. anthropologist of the early and mid-1900's. His work laid the foundation for modern anthropological theories about the influence of culture on human behavior and development.

Boas's work focused on the diversity of human cultures, languages, and physical types. Contrary to the accepted beliefs of his day, Boas argued that such differences are determined primarily by environment, not heredity. Boas was one of the first anthropologists to emphasize *field research*—that is, studying a people by living among them. Many of his theories were based on his research among the Indians of the Pacific Northwest. His books include *The Mind of Primitive Man* (1911) and *Race, Language, and Culture* (1940).

Boas was born in Minden, Germany. He came to the United States in 1886 and became a citizen in 1891. He taught at Columbia University from 1896 until his retirement in 1936. There, he trained many leading anthropologists, including Margaret Mead and Edward Sapir.

George W. Stocking, Jr.

See also **Anthropology** (Development of field research).

Boat. See **Boating; Ship.**

Boat racing. See **Iceboating; Motorboat racing; Rowing; Sailing.**

Matt Herron, DPI

A marina provides a secure mooring area for boats of all sizes, both power and sail. Millions of people throughout the world enjoy boating for recreation.

Boating

Boating brings pleasure to millions of people every year. Some people may enjoy paddling a canoe across a lake, while others enjoy fishing from an outboard boat or rowboat. Many others prefer to glide across the water on a sailboard or in a sailboat, while another large group prefers to fish or to speed along in a motorboat.

Boats are smaller than ships. Generally, most boats are not designed to travel across an ocean or similar large body of water. Boats are powered by oars or paddles, motors, or sails. Large engines power ships. For information on ships and commercial shipping, see the *World Book* article on **Ship**.

Types of boats

Canoes and rowboats are small boats without an engine or sails. They range in length from about 6 to 18 feet (1.8 to 5.5 meters). Boats that are powered by motors, sails, or both can run from about 12 feet (3.7 meters) to 150 feet (46 meters) or longer in length. A boat that is more than 40 feet (12 meters) long is often called a *yacht*. These crafts are often luxurious and include bunks, a *galley* (kitchen), and a *head* (toilet).

Motorboats. Most of the boats used for pleasure boating are less than 26 feet (8 meters) in length. A majority are motorboats. They are powered either by an *inboard* engine, contained inside the boat's hull, or an *outboard* motor, which is mounted on the *stern* (back) of the boat. Some boats combine both these features, with the engine inside the hull and the driving gears and propeller within a unit at the stern. These designs are called an *inboard/outboard (I/O)* or *sterndrive*.

Among the most popular type of motorboat are water-skiing boats, fishing boats, and day-cruising boats called *runabouts*. They generally range from 16 to 26 feet (5 to 8 meters) in length. Those between 16 and 20 feet long are usually powered by outboard motors producing 40 to 75 horsepower (30 to 56 kilowatts). However, outboards that produce at least 200 horsepower (150 kilowatts) are available for larger boats.

A number of motorboat designs with an overall length of at least 20 feet have a cabin in the forward part of the boat with one or two bunks. Unless a motorboat is exceptionally large, one person can operate it. Many motorboats more than 30 feet long have two inboard engines. This additional power enables the boat to travel at higher speeds. The twin propellers and rudders also make this type of motorboat more maneuverable than a boat with only one propeller.

A luxurious motorboat with a length of between 40 and 100 feet (12 and 30 meters) is often called a *motor yacht*. Similar craft that are more 100 feet in length are often called *super yachts*. or *mega yachts*. Both types

Charles Mason, the contributor of this article, is the Executive Editor of Sail Magazine.

have several cabins with bunks, showers or bathtubs, a well-equipped galley, and dining and recreation areas both on deck and below. Generally, these yachts will have two engines and sophisticated electronic navigation equipment, including radar, radio telephones, and electronic satellite navigation equipment. Such a yacht is usually constructed of aluminum or fiberglass.

Sailboats, like motorboats, can range from small craft less than 10 feet long to super yachts more than 150 feet in length. No matter what its size, if the boat has one hull, its rig will determine the type of craft. For example, a *sloop* has one mast supporting a mainsail and one *headsail* (a sail in front of the mast). A boat with two headsails is a *cutter.* A *schooner* can have two or more masts of similar height. Other two-masted sailboats are the *ketch* and the *yawl.*

Some sailboats have two or three hulls. A boat with two hulls is called a *catamaran.* One with three hulls is called a *trimaran.* These craft are called multihulls and tend to be faster than *monohull* (single hull) boats. Multihull sailboats can range in length from small boats suitable for day sailing to large oceangoing vessels.

A *houseboat* is generally powered by an inboard engine. These craft are principally designed for use in sheltered waters. They feature large living and sleeping spaces designed into the hull and deck structure.

A *hydrofoil* craft rides on at least three fins called *foils.* When the engines or sails provide sufficient power, the foils produce enough lift to bring the hull out of the water up onto the foils. This reduces or eliminates frictional drag on the hull.

A number of other power and sail designs are intended to perform work-related tasks. These designs include fishing boats, rescue boats, fire and patrol boats, and tugboats and tow boats.

Boating safety

Boating regulations. Boats must be handled properly, like automobiles. Many countries have specific rules for the operation of motor-powered boats and for sailboats being driven by sails alone. In the United States, for example, the U.S. Coast Guard publishes the *Navigation Rules, International-Inland.* They apply to the operation of all vessels on the high seas and on all inland waters in the United States. The International Rules and the Inland Rules differ only slightly. They govern navigation lights, sound signals, distress signals, and rules for meeting and passing. Both sets of rules state that a vessel must be operated at a speed that always allows the operator to take action in time to avoid a collision.

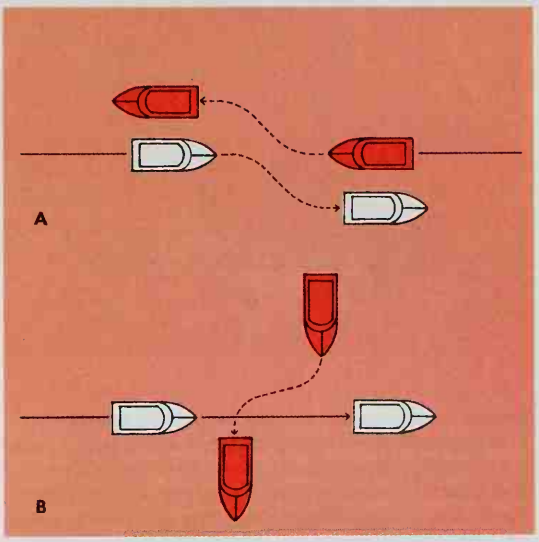
Certain rules apply to motorboat operation. For example, when two boats approach each other head-on or almost head-on, both must alter course to pass each other on the *port* (left) side. When two boats are approaching each other at right angles, the boat that has the other on its *starboard* (right) side must alter course to keep clear of the other boat. Preferably, it should pass *astern* (behind) the boat on its right.

Boaters must follow other rules in addition to those concerning navigation. For example, each boat has its own carrying capacity. Overloading can cause a boat to capsize or become filled with water and become swamped. Boaters should also learn local rules concerning *personal flotation devices* (PFD's). These devices are designed to keep an individual afloat in the water. There are many kinds of PFD's, and a boater is responsible for knowing what type is appropriate.

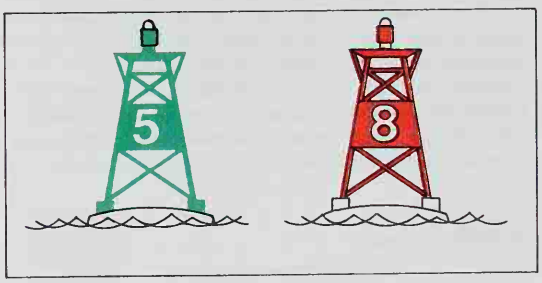
Many countries require boats to be registered with a government agency that will issue an identification number. This number must be displayed on both sides of the boat. Identification numbers help others to identify a boat that may have been operated in a reckless fashion. They also can aid in tracing a lost or stolen craft.

A few countries, and some states in the United States, require operators of private pleasure boats to be licensed. If a boat is being operated for hire, however, some countries, including the United States, require that the operator of the craft be licensed by the Coast Guard or a similar agency. Numerous categories for operating licenses exist, depending upon the size of the craft, what

The rules of the water

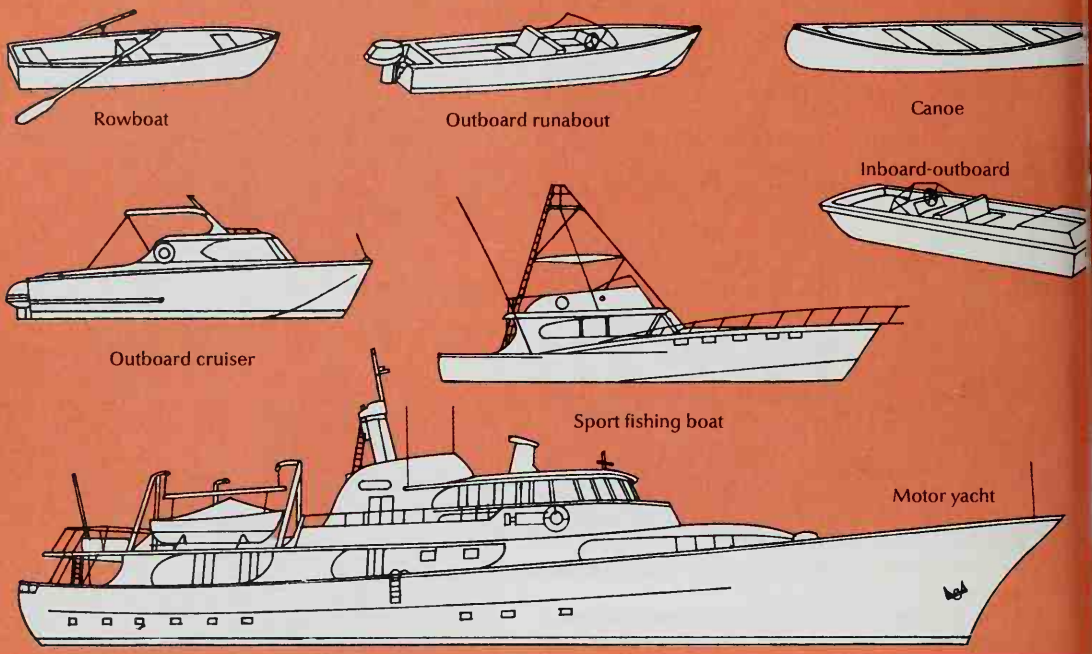


Safety rules help prevent boating accidents. Two important rules are (A) When two boats approach head-on, both must alter course so they pass each other on the left. (B) When two boats cross, the one with the other boat on its right must alter course.



Buoys mark safe channels for boaters. In the United States, red, even-numbered buoys mark the right side of a channel for ships entering a harbor. Green, odd-numbered buoys mark the left side. Buoys may also have whistles, bells, and lights installed to help boaters locate them at night or in reduced visibility. In some countries, the colors marking the channels are reversed.

Kinds of boats Pleasure boats range in size from a canoe to a large motor yacht. They include vessels powered by motors and sails, and craft propelled by oars. The kinds of boats shown here all provide recreation, but many have other uses as well. For example, some hydrofoils carry commercial passengers, and many families live aboard houseboats.



work it is engaged in, and where it will be operated.

Buoys and other safety aids. Most navigable waters are marked by fixed floating buoys of various shapes and colors, depending on where in the waterway they are. Colors and meaning can vary from country to country. In the United States, a boat entering a harbor from the sea will always find red buoys marking the right side of the channel and green buoys marking the channel's left side. Some countries use red buoys on the left and green on the right. All red buoys in the United States have an even number, while green buoys have an odd number. When entering a harbor, the numbers on both sides of the channel will be sequential and will increase as they move farther away from the entrance.

Some buoys have lights. In addition, buoys may have a horn, bell, or whistle as well as a radar reflector. All these devices allow the buoy to be located more easily in reduced visibility. See **Buoy.**

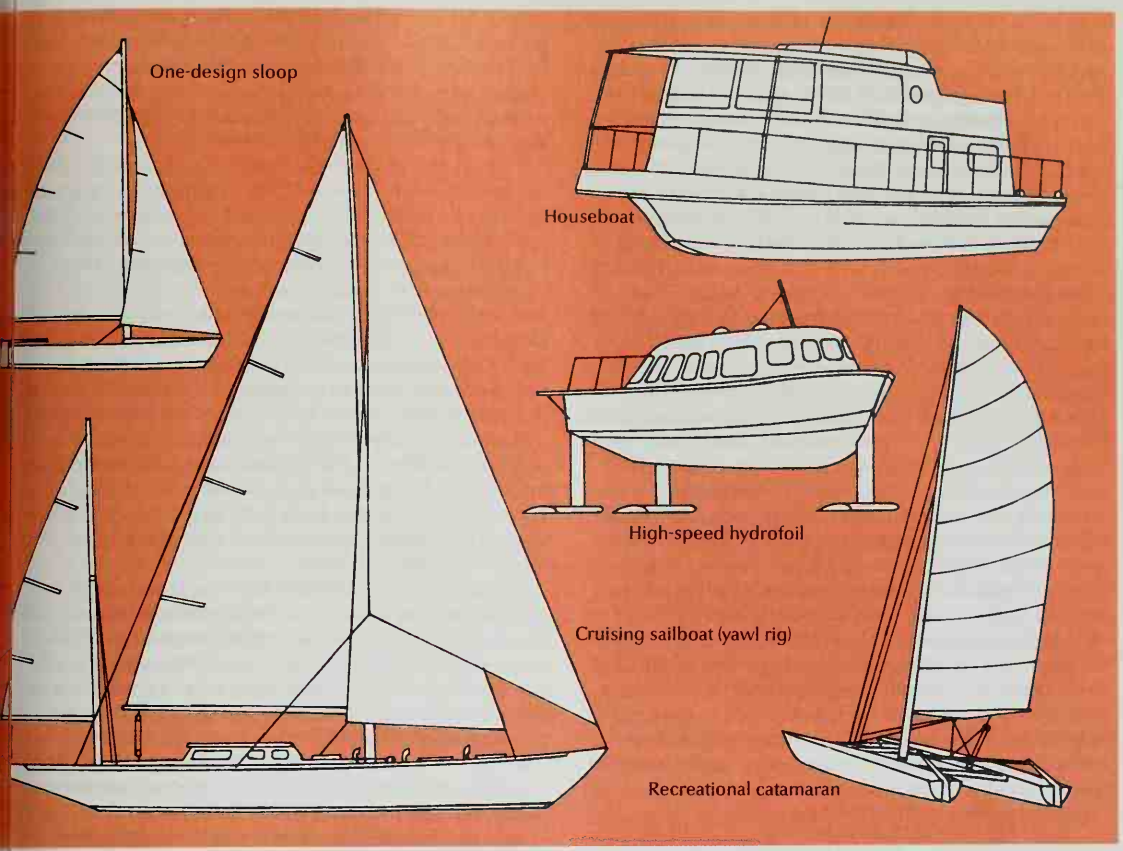
Some areas have lighthouses that contain a powerful signal light and perhaps a foghorn. Both devices can help boaters locate their position at night or in reduced visibility. Some lighthouses, as well as Coast Guard stations and yacht clubs, may display visual signals that indicate future wind speed and weather conditions. Everyone who goes out on the water should be familiar with the meaning of these signals, particularly the single red pennant of a *small craft advisory*, a signal that warns of weather conditions dangerous to small boats. However, even if no signals are flying, sudden increases in wind speed can occur when squalls or thunderstorms are nearby. See **Beacon; Lighthouse.**

Several on-board aids can help navigate a boat. They include a compass and *charts* (marine maps). Charts provide important navigational details, such as the depth of the water, location of sand banks and *shoals* (shallow places), and location of buoys. On-board radios tuned to

Warning signals

A small craft advisory warns of danger to small boats. *Day:* A red pennant. *Night:* A red light over a white light.

Gale warning indicates winds of 39 to 54 miles (63 to 87 kilometers) per hour. *Day:* Two red pennants. *Night:* A white light over a red light.



stations reporting local weather conditions keep boaters informed of potential hazards.

Boating safety programs. Many organizations teach boating safety. Many yacht clubs and community boating organizations offer sailing and racing programs for both junior and adult sailors. National training organizations include the Australian Yachting Federation; the Canadian Power and Sail Squadrons; the Royal Yachting Association in the United Kingdom; and United States Sailing, BoatUS, and the United States Power Squadrons in the United States.

History

Early boats. The first boats were made from large logs that had been burned or scraped to make dugout canoes. Sails and *outriggers* were later added to those hulls. An outrigger is a float extending away from the hull to keep the craft from overturning.

The North American Indians developed the canoe style of boat, which was light and easy to carry from one body of water to another. The Inuit (sometimes called Eskimos) made seaworthy kayaks from animal skins. Pacific Islanders and other African, Asian, and South American groups fashioned canoes and boats by attaching wooden planks with twine or constructing boats from reed, wicker, and other woven materials.

The development of pleasure boating. Historians do not know when pleasure boating began. A luxurious barge owned by Queen Cleopatra of Egypt was a familiar sight on the Nile River more than 2,000 years ago. During the early 1600's, the people of the Netherlands sailed a small, fast boat they called a *jaght* or *jaghtschip.*

The Water Club of the Harbour of Cork Harbour was founded in Ireland in 1720 and is considered the first yacht club. It still exists and is known as the Royal Cork Yacht Club. One of the first in the United States, the New

Storm warning stands for winds of 55 to 73 mph (89 to 117 kph). *Day:* A square red flag with black square. *Night:* Two red lights.

Hurricane warning represents winds of 74 mph (119 kph) and up. *Day:* Two red flags with black squares. *Night:* A white light between two red lights.

York Yacht Club, was formed in 1844.

The growth of boating. Boating grew rapidly in popularity during the 1900's as family income increased. Pleasure boating increased most rapidly in countries with a long tradition of seafaring; with many navigable lakes and rivers; and with large numbers of harbors, marinas, and moorings. Boating became especially popular in Finland, New Zealand, Norway, and Sweden. Other major boating countries include Australia, Canada, Denmark, France, the Netherlands, New Zealand, and the United States.

Boating today. Improved outboard engines have been an important part of boating growth. Engines have become more efficient, lighter, and more affordable. Four-stroke outboard engines are replacing the older two-stroke machines in which oil and fuel were mixed together. Parts made of aluminum, plastic, and composite materials have made the outboard motor much lighter. Similar improvements have been made in hull construction. Fiberglass is a heavy material, but it is easily molded into various shapes. The newest fiberglass hulls may have a foam core sandwiched between two layers of glass to produce a stiffer and lighter hull.

The increased efficiency of automobiles and trucks has also helped the growth of boating because these vehicles tow many smaller boats under 26 feet in length. A boat can now be taken out of the water, put on a trailer, transported, and stored in a garage or on a driveway. Local governments have also contributed to the growth of boating by constructing public launching facilities and marinas where boats can be tied up and left in a secure location. Charles Mason

Related articles in *World Book* include:

Kinds of boats

Barge	Gondola	Junk	PT boat
Catamaran	Houseboat	Kayak	Sampan
Ferry	Hydrofoil	Outrigger	Steamboat
Flatboat	Hydroplane	Pirogue	Tugboat

Other related articles

Beacon	Fishing industry (pictures)	Rowing
Buoy	Iceboating	Sailing
Canoeing	Life jacket	Ship
Coast Guard, United States (pictures)	Motorboat racing	Transportation (pictures)

Additional resources

Gerr, Dave. *The Nature of Boats.* 1992. Reprint. International Marine, 1995.
Kentley, Eric. *Boat.* 1992. Reprint. Dorling Kindersley, 2000. Younger readers.
Maloney, Elbert S., ed. *Chapman Piloting: Seamanship & Boat Handling.* Hearst Marine. New editions published frequently.
Maloney, Elbert S., and Bottomley, Tom. *Boater's Handbook.* 3rd ed. Hearst Marine, 2002.
Mendlowitz, Benjamin, and Bray, Maynard. *The Book of Wooden Boats.* 2 vols. Norton, 1992, 2000.
Thompson, Luke. *Essential Boating for Teens.* Children's Pr., 2000.

Bob Jones University is a Christian, coeducational liberal arts institution in Greenville, South Carolina. It is the largest fundamentalist school in the world, with about 5,500 students from the United States and more than 40 other nations.

The university, established by the world-famous evangelist Bob Jones, Sr., stresses the fundamentalist belief in the absolute authority of the Bible. About a third of the students train for some form of service as Christian leaders. The university program includes courses in church administration, missions, business, computer science, law, medicine, nursing, engineering, farm management, education, and the humanities.

Bob Jones University was founded in Florida in 1927. It moved to Greenville in 1947. The university owns an outstanding collection of religious art and is known for its production of Christian educational motion pictures and its performances of operas and Shakespearean plays.

Critically reviewed by Bob Jones University

Bobby. See **Peel, Sir Robert; Police** (History).

Bobcat is a North American wildcat named for its short tail, which resembles a *bob*, or knob. A bobcat's fur varies in color from tan to reddish-brown and has spots. The animal has pointed, tufted ears and a ruff of fur on the sides of its face. Adults commonly measure from 24 to 45 inches (60 to 114 centimeters) long. Males are heavily built and weigh from 20 to 30 pounds (9 to 14 kilograms). Females weigh from 13 to 20 pounds (6 to 9 kilograms). Bobcats in northern North America tend to grow larger than other bobcats.

The bobcat ranks as North America's most common wildcat, ranging from southern Canada to Mexico. It can live in deserts, forests, mountains, and swamps. Though more tolerant of people than many other wildcats, bobcats tend to avoid large cultivated areas. Females are more territorial than males. Both sexes mark their territory with urine or other body wastes and secretions.

Bobcats are active at twilight and through the night. Their diet consists primarily of rabbits, but they also eat birds, rodents, and occasionally young deer.

Bobcats mate in late winter or early spring. Females make dens under logs, in thickets, or in hollow trees. They normally give birth to 2 to 3 kittens at a time. The young remain with their mother 9 to 12 months before becoming independent. Bobcats live 12 to 13 years in

Leonard Lee Rue III

The bobcat uses its keen eyesight and hearing to track down the small animals on which it feeds. Bobcats can live in deserts, forests, mountains, and swamps of North America.

the wild and up to twice that in captivity.

People trap bobcats for their pelts. However, hunting and trade of the bobcat is regulated, and the species is protected in some parts of its range. Elizabeth S. Frank

Scientific classification. Bobcats belong to the cat family, Felidae. The scientific name of the bobcat is *Lynx rufus.*

Bobolink is a North American songbird related to blackbirds and orioles. It is named for the sounds in its bubbly song, *bob-o-lee, bob-o-link.*

The bobolink is about 7 inches (18 centimeters) long. In the fall, both the male and the female are tan with dark stripes on their heads and backs. In late spring and in summer, the male is black with yellow and white patches on the head, back, and wings.

Bobolinks migrate long distances between their summer and winter homes. During the summer, when they breed, bobolinks live in the northern and central United States, and in Canada. They spend the winter in South America, from central Brazil to Argentina. They begin flying south in July and August, while the weather is still warm. Along the way, they often stop to feed in rice fields. For this reason, bobolinks are sometimes called *ricebirds.* The birds return north in the spring.

Bobolinks nest in fields and meadows. They build a simple nest on the ground beneath tall grasses or clover. The female bobolink lays four to seven eggs, which are whitish-gray or tan with lilac and brown spots and streaks. Martha Hatch Balph

Scientific classification. The bobolink belongs to the subfamily Icterinae of the emberizid family, Emberizidae. Its scientific name is *Dolichonyx oryzivorus.*

See also **Bird** (pictures: The bobolink; Birds' eggs); **Blackbird; Oriole.**

Bobsledding is a fast, dangerous winter sport in which teams of two or four persons ride down a steep, icy course in steel and fiberglass sleds. The sleds may reach speeds up to 90 miles (145 kilometers) per hour. The team with the fastest total time after either two or four runs wins the competition.

A bobsled course has sharp turns and banked walls. A typical course ranges from 1,200 meters (1,312 yards) to 1,500 meters (1,640 yards) long.

At the start of the run, the team members line up on a *start block,* grasp the sled, and begin their run. The time starts when the sled passes the timing light 15 meters (16.5 feet) from the start block. The team members push the sled as they run alongside or behind. They jump on after about 50 meters (164 feet). This procedure helps to get the sled off to a fast start. The front person steers. The rear person controls braking, which stops the sled at the end of the run. Teamwork is essential to keep the sled on the course and to save the fractions of a second that mean the difference between winning and defeat.

© Glyn Kirk, Action Plus from Icon SMI

Bobsledding is a winter sport for two-person and four-person sleds that race over an icy course with sharp turns and banked walls. A four-person sled, *shown here,* consists of the driver sitting in front, two pushers, and a brakeman sitting in the rear.

A two-man sled and team can weigh up to 390 kilograms (859 pounds), and a two-woman sled and team up to 350 kilograms (771 pounds). A four-person sled and team can weigh up to 630 kilograms (1,389 pounds). The sport began during the late 1880's in Albany, New York.

A one-person sled sport called *skeleton* also uses a bobsled course. In skeleton, riders lie on the sled with their head forward. They steer the sled by the movement of the head and shoulders.

Critically reviewed by the United States Bobsled & Skeleton Federation

See also **Olympic Games** (table: Bobsledding).

Bobwhite. See Quail.

Boccaccio, *boh KAH chee oh* or *boh KAH choh,* **Giovanni,** *joh VAHN nee* (1313?-1375), is generally considered the first great writer of prose in a modern language. Other major writers of his time, such as Geoffrey Chaucer of England and Petrarch and Dante of Italy, wrote their masterpieces in verse. Boccaccio's narrative poems and prose romances influenced Chaucer.

Boccaccio is best known for his masterpiece, the *Decameron* (about 1349-1353). The work consists of 100 stories masterfully organized to give the impression of a total view of society. In the introduction, three young men and seven young women flee to the country to escape an outbreak of the plague in Florence in 1348. They spend two weeks there and hold storytelling sessions during the hot afternoons. Each day, the group elects a queen or king who determines the general theme of the stories for the following day.

The word *Decameron* is based on the Greek words for 10 days. The 100 stories, distributed over 10 days, are arranged in a progression of themes. The themes are designed to illustrate the interplay of the forces of love, fortune, and human intelligence.

Boccaccio is also credited with initiating several literary forms that later became popular in Italian literature. For example, his *Filocolo* is the first Italian prose romance. *Filostrato* is the first Italian romance in verse other than those written by minstrels. He also wrote *Ninfale Fiesolano,* the first Italian *idyll* (poem about country life).

Detail of a fresco portrait (mid-1400's) by Andrea del Castagno. Museo di Andrea Castagno e Cenecolo di Sant Appollonia, Florence (Alinari from Art Reference Bureau)

Giovanni Boccaccio

Boccaccio was the son of an Italian merchant. He was probably born in Certaldo, near Florence, Italy, but he spent most of his life in Naples and Florence. Boccaccio greatly admired Dante and Petrarch. He wrote many poems and prose works in Latin and in Italian, as they did. Most of his Italian works were

written in the 1330's and 1340's. Discouraged by public objection to some portions of the *Decameron* as obscene, Boccaccio devoted his later years to writing highly scholarly works in Latin. He also gave public lectures on Dante. Richard H. Lansing

Additional resources

Bergin, Thomas G. *Boccaccio.* Viking, 1981.
Serafini-Sauli, Judith P. *Giovanni Boccaccio.* Twayne, 1982.

Boccherini, *BAHK uh REE nee,* **Luigi,** *loo EE jee* (1743-1805), was an Italian composer and cellist. He wrote more than 500 works, many of them string trios, quartets, and quintets. Boccherini's compositions won recognition during his lifetime but were largely ignored throughout the 1800's and early 1900's. In the mid-1900's, they began to attract increasing interest because of their graceful, expressive melodies. Boccherini's most frequently performed works are his Concerto in B flat for cello (about 1770) and the minuet from his String Quintet No. 5 (1771).

Boccherini was born in Lucca, Italy, and studied composition and cello in Rome and Vienna. In 1767, he went to Paris, published his first works, and became known as a composer of chamber music. He traveled to Madrid, Spain, in 1769 and was appointed composer and chamber musician at the Spanish court. He remained there until his death, composing for publishers and patrons all over Europe, including King Frederick William II of Prussia. Joscelyn Godwin

Boccioni, *bah CHOH nee,* **Umberto,** *oom BEHR toh* (1882-1916), is considered the greatest Italian sculptor of the early 1900's. He was also a noted painter and one of a group of Italian experimental artists and poets who organized in 1909 as *futurists* (see **Futurism**). Boccioni's painting *The City Rises* is an excellent example of the futurist style.

In his sculpture, Boccioni tried to express certain futurist ideas about motion and space. Through distortion and the complex placement of forms, Boccioni attempted to represent the blend of an object with its path of movement or its surrounding space. His *Unique Forms of Continuity in Space* appears in the **Sculpture** article. Boccioni was the first to encourage and practice the free combination of different materials in sculpture. Boccioni was born in Reggio. Douglas K. S. Hyland

Bodensee. See **Lake Constance.**

Bode's law, *BOH duhz,* is a scheme for representing the approximate distances of the planets from the sun. The concept was devised in 1766 by Johann D. Titius, a German mathematician, before the discovery of the planets Uranus, Neptune, and Pluto. The German astronomer Johann E. Bode published the law in 1772, and it became associated with his name.

Bode's law operates according to a simple formula. Take the numbers 0, 3, 6, 12, 24, 48, 96, 192, 384, and 768. Each figure in the series, after 3, is obtained by doubling the preceding figure. Add 4 to every number and then divide each sum by 10. In the table with this article, the relative distances of the planets from the sun as derived from Bode's law are compared with their actual mean distances. The distances are given in *astronomical units.* An astronomical unit is equal to about 93 million miles (150 million kilometers), the mean distance of the earth from the sun.

The distances calculated by Bode's law approximate the actual distances except for Neptune and Pluto. Also, astronomers have not found a planet that corresponds to the position between Mars and Jupiter. But a number of asteroids almost match the distance of 2.8 astronomical units. Astronomers are uncertain about the significance of Bode's law in the study of planetary orbits.

Planet	Distance by Bode's law	Actual mean distance
Mercury	0.4	0.39
Venus	0.7	0.72
Earth	1.0	1.00
Mars	1.6	1.52
(Asteroids)	(2.8)	
Jupiter	5.2	5.20
Saturn	10.0	9.54
Uranus	19.6	19.18
Neptune	38.8	30.06
Pluto	77.2	39.30

Thomas E. Lutz

Bodet, Jaime Torres. See **Torres Bodet, Jaime.**

Bodhisattva, *BOH dee SAHT vuh,* in the Buddhist religion, is a person who strives to become a Buddha. Buddhists believe that Buddhas have developed certain moral and religious perfections, and have reached a state of complete enlightenment and peace called *nirvana.* Bodhisattvas vow to reach nirvana, but to delay entering it in order to work for the salvation of others. To achieve this goal, a bodhisattva follows Buddhist ways of life called the *Middle Way,* the *Noble Eightfold Path,* and the *Bodhisattva Path.*

Various branches of Buddhism differ in their interpretation of who may become a bodhisattva. For example, followers of the Mahayana branch are expected to take bodhisattva vows. Many of these followers worship various celestial bodhisattvas who they believe are gods. Many Mahayana rulers have identified themselves with one or more of these gods. For example, the Dalai Lamas of Tibet have traditionally claimed to be reincarnations of a bodhisattva named Avalokitesvara. Members of the Theravada branch and related branches regard few people as bodhisattvas. Frank E. Reynolds

See also **Buddha; Buddhism; Dalai Lama.**

Bodleian Library, *bahd LEE uhn* or *BAHD lee uhn,* is the main library of Oxford University at Oxford, England. It contains approximately 5 million books and more than 60,000 manuscripts. British copyright laws require that one copy of every book published in Britain must be given to the Bodleian Library if the library requests one.

The library's collections include original manuscripts by famous English authors. The original library, which consisted mainly of manuscripts given to the university by Humphrey, Duke of Gloucester, was discontinued about 1550. Thomas Bodley, an English statesman and scholar, reestablished the library in 1602. He donated new books, manuscripts, and money, and encouraged the generosity of other benefactors.

Critically reviewed by the Bodleian Library

Bodoni, *boh DOH nee,* **Giambattista,** *JAHM baht TEES tah* (1740-1813), an Italian printer and type designer, became the most celebrated printer in Europe at the end of the 1700's. He managed the Duke of Parma's press and issued elegant books. Bodoni also set up a type foundry. He designed his own types in a style called "modern faces," in which there is a strong con-

trast between the thick and thin portions of the letter. Type faces based on his designs remain popular today. Bodoni was born in Saluzzo, Italy. Peter M. VanWingen

Body, Human. See Human body.

Body language is communication by means of facial expressions, gestures, postures, and other wordless signals. Body language also includes grooming habits, hair and clothing styles, and practices, such as tattooing and body piercing. Body language communicates unspoken information about people's identity, relationships, and thoughts, as well as moods, motivation, and attitudes. It plays an essential role in all interpersonal relationships, such as child care, politics, teaching, and public speaking. The scientific study of body language is called *kinesics* (see Kinesics).

Body language signals can be inborn, learned, or a mixture of the two. Blinking the eyes, clearing the throat, and facial flushing are *innate* (inborn) signals. These signals are often involuntary. Facial expressions of happiness, anger, disgust, and other basic emotions are understood by people in all cultures. Laughing, crying, and shrugging the shoulders are examples of mixed signals. They may originate as innate actions, but cultural rules shape their timing and use. Gestures, such as a thumbs up, or a military salute, are learned signals. The meanings of such gestures vary among different cultures.

Body language can also reveal lies or feelings that a person may wish to hide. For example, lips pressed together may indicate disagreement or doubt, even if the person's verbal statements convey agreement. When verbal statements and body language conflict, listeners will more likely believe the nonverbal messages than what is spoken. David B. Givens

See also **Communication** (The study of communication).

Body temperature. See Temperature, Body.

Bodybuilding, or weight-training, is a sport and form of recreation in which people develop their muscles by lifting weights. By lifting progressively heavier weights, bodybuilders increase the size of their muscles.

Bodybuilding is a conditioning and fitness activity. It can increase strength, speed, muscle endurance, and flexibility. When practiced correctly, bodybuilding can also strengthen the heart and improve circulation.

Amateur and professional competitions are held for both men and women bodybuilders. The International Federation of Bodybuilders (IFBB) governs professional competitions. Competitors are judged in three rounds—the symmetry round, for shape, structure, and muscle proportion; the muscularity round, for size and definition of the muscles; and the posing presentation round, for poses in routines set to music. Bodybuilding differs from competitive weightlifting, in which athletes compete to determine who can lift the most weight. See **Weightlifting.** Jeff M. Everson

Boehmeria, *boh MIHR ee uh* or *bay MIHR ee uh,* is a group of plants in the nettle family. About 50 species have been identified. The group includes herbs, shrubs, and trees that are found in warm regions of the world. One kind, called *false nettle,* grows as a wildflower in moist, shady areas throughout the eastern United States and from Florida to Texas. Another kind, native to China and Japan, is cultivated for its strong and silky fiber. These plants and their fibers are called *ramie, China grass,* or *rhea.* See also **Ramie.** David S. Seigler

Scientific classification. Boehmeria are in the nettle family, Urticaceae. The scientific name for false nettle is *Boehmeria cylindrica.* Ramie is *B. nivea.*

Boeing, *BOH ihng,* **William Edward** (1881-1956), was an American industrialist. In 1916, he helped found the Pacific Aero Products Company (now called the Boeing Company). The firm is one of the world's largest manufacturers of airplanes and of airplane and spacecraft equipment. Boeing also helped carry the first international airmail in one of his planes in 1919, and set up Boeing Air Transport in 1927. UAL Corporation (United Air Lines) developed from this pioneer airline.

Boeing was born on Oct. 1, 1881, in Detroit. He attended the Sheffield Scientific School at Yale University. In 1903, he moved to Seattle, where he organized a lumber business. After the Pacific Aero Products Company was formed, Boeing served as its president and later as chairman of its board of directors. Ronald J. Ferrara

Boeotia, *bee OH shuh,* was a district of ancient Greece that lay northwest of Athens. It had an area of about 1,100 square miles (2,850 square kilometers). The land was rich, and most of it was developed in farms and small towns. Thebes, the chief city, led a group of cities called the Boeotian League, which helped Persia invade Greece. The Boeotians fought with the Spartans against Athens in the Peloponnesian War. The Theban generals Epaminondas and Pelopidas led the Boeotian League to victory over a Spartan army at Leuctra in 371 B.C., and the League was the most important power in Greece for 10 years afterward. Philip II of Macedonia defeated Thebes and Athens in the battle of Chaeronea in 338 B.C. Boeotia is now a department of Greece. See also **Thebes** (Greece). Linda J. Piper

Boer War, *bawr,* also called the *South African War,* was fought from 1899 to 1902. It was between the British and the *Boers* (now called Afrikaners) of the northern South African regions of the Orange Free State and the South African Republic (also called Transvaal). Most of the Boers were farmers of Dutch ancestry. The main causes of the war were the struggle for supremacy in South Africa and ill will between the Boers and the *Uitlanders* (foreigners). Uitlanders were mainly British subjects. In 1880 and 1881, the Boers had fought for and regained the independence of the South African Republic, which the British had annexed in 1877. That struggle is often called the *First Boer War.*

Many Uitlanders rushed into the South African Republic after the discovery of the Witwatersrand gold fields there in 1886. The Boers worked to deny them full political rights and power. In 1895, some Uitlanders joined in an unsuccessful uprising led by Leander Jameson. Peaceful attempts to settle the problem failed. The Orange Free State joined the South African Republic in declaring war on the United Kingdom in October 1899. Many British and Europeans opposed the British South African policy before and during the war.

The Boers won victories during the early stages of the war. In January 1900, Lord Roberts and Lord Kitchener brought in many more British troops. The British captured the capitals of the two republics early in 1900. General Louis Botha's Boer army surrendered to Lord Roberts in September. The remaining Boer forces took to the countryside, where they carried on guerrilla

warfare. They finally surrendered in May 1902. The two defeated republics became British colonies.

The Treaty of Vereeniging was signed on May 31, 1902. The Boers agreed to stop fighting and swear allegiance to King Edward VII. The British allowed all prisoners to go home, and agreed not to punish anyone for his or her part in the war. Denis Judd

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Hertzog, James Barry Munnik
Kimberley
Kitchener, Horatio H.
Kruger, Paulus
Rhodes, Cecil John
Smuts, Jan Christiaan
South Africa (Discovery of diamonds and gold)

Additional resources

Pakenham, Thomas. *The Boer War.* 1979. Reprint. Random Hse., 1994.
Warwick, Peter, ed. *The South African War: The Anglo-Boer War, 1899-1902.* Addison Wesley Longman, 1980.

Boers. See Afrikaners.

Boethius, *boh EE thee uhs,* **Anicius Manlius Severinus** (A.D. 480?-524?), was a Roman philosopher. He was best known for *Consolation of Philosophy,* a book he wrote in prison awaiting execution for treason. The work is a dialogue between Philosophy, in the form of a woman, and Boethius. She teaches him that the highest good is the contemplation of God, which also reconciles a person to misfortune on earth.

Boethius was born in Rome. He was a high government official under the Ostrogoth king Theodoric. Boethius wrote books on arithmetic and music that were used as textbooks throughout the Middle Ages. He wanted to translate the works of the Greek philosophers Plato and Aristotle into Latin and demonstrate the agreement between the two. His translations of Aristotle's works on logic preserved these theories during a time when classical learning was being lost. Marilyn J. Harran

Bog is a type of wetland in which the soil is acidic, lacking in oxygen, and low in minerals. These conditions hinder the decay of plant and animal matter. As a result, partially decayed organic matter accumulates as *peat.* The peat forms a springy, spongy soil in which bog plants grow. Peat mosses, also called *Sphagnum,* usually cover the peat surface.

Bogs usually develop in poorly drained sites. They are especially common in areas with cold, wet climates, such as northern Asia, northern Europe, Canada, and the U.S. states of Alaska, Maine, and Minnesota. Large bogs may cover several square miles and have peat deposits up to 45 feet (14 meters) deep.

In the early stages of bog development, the peat layer is shallow and often forms a floating mat on the surface of a lake or pond. These floating mats sink slightly when walked on and bogs in this stage are called *quaking bogs.* The peat may accumulate to such an extent that it rests on the bottom of a lake or pond. Then the bog no longer quakes and can support the growth of trees.

The environment of bogs limits the number and kinds of plants and animals that survive there. Common plants include heaths, sedges, conifers, and carnivorous plants such as sundews and pitcher plants. Many insects live in bogs, especially beetles, dragonflies, and mosquitoes. Birds, frogs, and bog lemmings are also found in bogs.

In the peat of some bogs, scientists have found the well-preserved remains of plants and animals that died thousands of years ago. These remains are of great value in the study of the past. Eric F. Karlin

See also **Cranberry; Marsh; Peat; Peat moss; Wetland.**

Bogart, *BOH gahrt,* **Humphrey** (1899-1957), was an American motion-picture actor. His rugged face, flinty voice, and gruff but sensitive attitude made him one of the most popular motion-picture "tough guys."

Humphrey DeForest Bogart was born on Dec. 25, 1899, in New York City. He made his feature film debut in *A Devil with Women* (1930). He achieved his first movie fame in *The Petrified Forest* (1936), where he portrayed gangster Duke Mantee, a part he had played on stage in 1935. He also played gangsters in *Dead End* (1937), *The Roaring Twenties* (1939), and *High Sierra* (1941). Writer-director John Huston helped give Bogart a new image by casting him as detective Sam Spade in *The Maltese Falcon* (1941). Bogart went on to star in five more of Huston's films, including *The Treasure of the Sierra Madre* (1948), *Key Largo* (1948), and *The African Queen* (1951). Bogart won an Academy Award for best actor in *The African Queen.* His most popular performance as a romantic leading man was in *Casablanca* (1942). His other important films include *Sahara* (1943), *The Big Sleep* (1946), and *Sabrina* (1954). Louis Giannetti

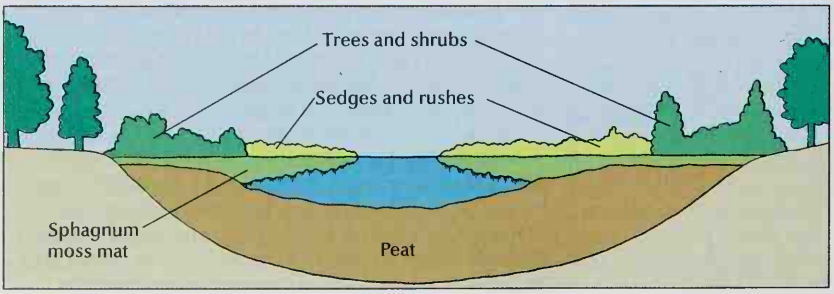
The Penguin Collection

Humphrey Bogart

Additional resources

Meyers, Jeffrey. *Bogart.* Houghton, 1997.

WORLD BOOK diagram



A quaking bog has a floating mat of *Sphagnum,* a type of moss. The Sphagnum is kept afloat by plant stems and other items that also float in the water. Large quantities of partly decayed plant life called *peat* accumulate under the Sphagnum mat.

Sperber, A. M., and Lax, Eric. *Bogart.* 1997. Reprint. Morrow, 1998.

Bogong moth, *BOH gawng,* is an Australian moth that has become a serious agricultural pest. The *larvae* (young) of bogong moths, called *cutworms,* attack tomatoes, corn, and winter pastures in the lowlands of New South Wales and Queensland. In summer, hatchling moths migrate to cooler mountainous areas. There they cluster in large numbers on rock crevices and *estivate* (remain inactive) by living off reserves of body fat.

Bogong moths range in color from light brown to almost black, with some lighter markings. Adults have a wingspan of about 2 inches (5 centimeters). These moths once provided Australian Aborigines with an important source of food. Bernd Heinrich

Scientific classification. The Bogong moth is in the owlet moth and underwing moth family, Noctuidae. It is *Agrotis infusa.*

Bogotá, *BOH guh TAH* (pop. 5,484,244), is the capital and largest city of Colombia. It is the center of a metropolitan area with a population of about 7 million. Bogotá lies on a plateau about 8,660 feet (2,640 meters) above sea level, in the Andes Mountains in central Colombia (see **Colombia** [map]).

The steep mountains that surround much of Bogotá give the city a dramatic physical setting. One peak is crowned with a figure of Christ, another with a cross, and a third with a shining white convent. Cable cars travel between the city and the top of Monserrate, a mountain that is a popular observation point. A mansion at the foot of the mountain once belonged to the South American general Simón Bolívar. It is now a museum that displays items relating to Bolívar and South America's struggle for independence.

At the center of Bogotá is the main square, Plaza Bolívar. It is surrounded by historic buildings, including the Cathedral, the Archbishop's Palace, the Municipal Palace, and the Capitol. Nearby, mansions from the Spanish colonial era, which lasted from the 1500's to the early 1800's, line the narrow streets. The Gold Museum has a collection of about 35,000 gold works of art crafted by Indians before the Spaniards arrived.

Gerard Boutin, Explorer

Bogotá, the capital and largest city of Colombia, lies on a plateau high in the Andes Mountains. The city's skyline includes many high-rise office buildings and hotels.

Bogotá's population doubled between 1973 and 1993. Many people have come to Bogotá to escape violent conflicts between the government and rebels in other regions of Colombia. Crime and poverty are among the city's problems. Much of the city's economic activity is service-oriented. Many banks and insurance companies operate in Bogotá. Factories in the city process food and manufacture chemicals, medicines, and other products.

Bogotá was founded in 1538 by Gonzalo Jiménez de Quesada, a Spanish military leader who conquered the area's Chibcha Indians. In the early 1700's, the city became the capital of the Viceroyalty of New Granada. The viceroyalty consisted of what are now Colombia, Venezuela, Ecuador, and Panama. In 1830, Bogotá became the capital of independent New Granada, later renamed Colombia. Cristina Rojas

See also **Colombia** (picture).

Bohemia, *boh HEE mee uh,* is a region in the western part of the Czech Republic. It covers 20,374 square miles (52,768 square kilometers) and has about 6,300,000 people, or about 60 percent of the republic's population.

Bohemia is a saucer-shaped plateau ringed by hills and mountains. The Sudeten Mountains form Bohemia's northeastern boundary, and the Bohemian Mountains form the region's western boundary. The Elbe River Valley in the north includes the most fertile farmland. Farmers there raise such crops as rye, sugar beets, and wheat. Bohemian farmers also produce barley, oats, and potatoes, and they raise cattle and hogs.

Most Bohemians belong to a Slavic group called Czechs. Industries employ about two-thirds of the workers. Manufactured products of the region include beer, Bohemian crystal and cut glass, chemicals, cloth, iron and steel, and machinery. Cultural life centers in Prague, the Czech Republic's capital and largest city.

The first known inhabitants of Bohemia were the Boii, a Celtic tribe that lived in the region during the 300's B.C. The name *Bohemia* comes from the word *Boii.* The Czech word for Bohemia, *Čechy,* refers to the Czechs, who had settled in the region by about A.D. 500. In 1158, Emperor Frederick I of the Holy Roman Empire gave the title of king to the Duke of Bohemia. Bohemia reached its political and cultural peak in the 1300's, when Charles IV ruled as king and Holy Roman emperor.

A period of civil wars called the Hussite Wars began in 1419, following the execution of John Hus. Hus was a Bohemian religious reformer (see **Hus, John**). The wars were mainly religious conflicts in which Hus's followers fought loyal Roman Catholics. The two sides reached a compromise in 1436. In time, most Bohemians became Protestants. Bohemia came under the rule of the Catholic Habsburg family in 1526. The Bohemian Protestants overthrew the Habsburgs in 1618, but the Habsburgs regained power in 1620.

WORLD BOOK map

Bohemia, a region in the western part of the Czech Republic, includes Prague, the capital.

The Bohemian revolt began the Thirty Years' War (see **Thirty Years' War** [The Bohemian period]).

The Habsburgs ruled Bohemia for almost 400 years. Bohemia lost most of its religious and political freedom under Habsburg rule. Beginning in the late 1700's, Czech leaders in Bohemia worked for a rebirth of patriotism and culture. The Bohemian people unsuccessfully revolted in 1848. Bohemia became industrialized during the 1800's.

The Habsburg empire of Austria-Hungary was one of the losing nations in World War I (1914-1918). In 1918, Bohemia became a province of the new independent republic of Czechoslovakia. The government of Czechoslovakia abolished the country's provinces in 1949. In 1993, the independent nations of the Czech Republic and Slovakia were created to replace Czechoslovakia. Bohemia became a region in the Czech Republic. Vojtech Mastny

See also **Czech Republic; Moravia; Prague.**

Bohr, Niels (1885-1962), was a noted Danish physicist who developed a theory about the structure of the atom. Bohr's theory, published in 1913, was based on an earlier one proposed by Ernest Rutherford, a British physicist. Rutherford had shown that the atom consisted of a positively charged nucleus, with negatively charged electrons whirling around the nucleus. Bohr proposed that the electrons could travel only in certain successively larger orbits around the nucleus. He thought the outer orbits could hold more electrons than the inner ones. Bohr also suggested that the electrons in the outermost orbit determined the atom's chemical properties.

Bohr, aided by a theory proposed by the German physicist Max Planck, described the way atoms emit radiation (see **Planck, Max**). Bohr assumed that when an electron jumps from an outer orbit to an inner one, it emits light. His theory explained the way light is given off by hydrogen, the simplest atom. Later, other scientists expanded Bohr's theory into *quantum mechanics*. This field of physics explains the structure of more complex atoms, the way they give off light, and other related matters (see **Quantum mechanics**).

Bohr was born in Copenhagen, Denmark. He received a doctor's degree in physics at the University of Copenhagen in 1911. That same year, he traveled to Cambridge, England, to study under the noted British physicist Sir Joseph J. Thomson. Bohr went to Manchester, England, in 1912 to work with Rutherford.

In 1916, Bohr became a professor of physics at the University of Copenhagen. Danish authorities built the Institute for Theoretical Physics there in 1920, and Bohr became its director. Bohr won the 1922 Nobel Prize in physics chiefly for his work on atomic structure. During the 1930's, Bohr made many contributions to the study of the nucleus of the atom and to an understanding of quantum mechanics.

In 1943, during World War II, Bohr fled from Copenhagen to escape the Nazis. He traveled to Los Alamos, New Mexico, where he advised scientists working on the first atomic bomb. He returned to Copenhagen after the war ended in 1945. Bohr later promoted peaceful uses of nuclear energy. Roger H. Stuewer

See also **Atom** (diagram: Models of the atom).

Bohrium is an artificially produced radioactive element with 107 protons—that is, with an *atomic number* of 107. Scientists have discovered three *isotopes* of bohrium, forms of the element with the same number of protons but different numbers of neutrons. The *atomic mass numbers* (total numbers of protons and neutrons) of these isotopes are 260, 261, and 262. The most stable isotope has a mass number of 262 and a *half-life* of 0.102 second—that is, due to radioactive decay, only half the atoms in a sample of isotope 262 would still be atoms of that isotope after 0.102 second.

Bohrium is named after Danish physicist Niels Bohr, who made many contributions to the study of the atomic nucleus. The chemical symbol for bohrium is Bh.

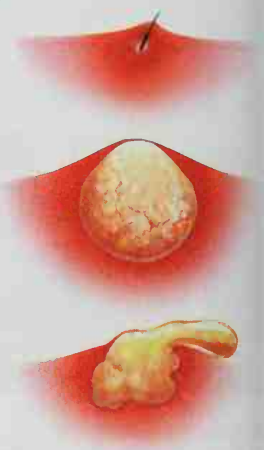
In 1976, scientists at the Joint Institute for Nuclear Research in Dubna, near Moscow, first announced the production of the element. Dubna was then part of the Soviet Union and is now in Russia. In 1981, a group at the Heavy Ion Research Center in Darmstadt, West Germany (now part of Germany), made a rival claim. The scientists at Darmstadt had bombarded bismuth, whose atomic number is 83, with chromium, which has an atomic number of 24. The Darmstadt work, unlike that of the Soviets, provided definitive evidence of the atomic number and atomic mass of the element.

In 1986, the International Union of Pure and Applied Chemistry (IUPAC) and the International Union of Pure and Applied Physics formed a working group to review the histories of the elements with atomic numbers from 101 to 109. IUPAC is the recognized authority in crediting the discovery of elements and assigning names to them. In 1993, IUPAC accepted the working group's conclusion that the Germans deserved credit for the discovery of the element. Disagreements about what to name the element delayed an official naming until 1997, however. Before being named, bohrium had commonly been referred to as *element 107*. Richard L. Hahn

Boil is a painful infection of the skin and tissues under the skin. A boil begins as a hard, red lump. Within a few days, the center of the lump softens and fills with pus. Most boils develop on the face, armpits, chest, and buttocks.

Boils are caused by bacteria called *staphylococci*. In most cases, the bacteria enter the skin around a hair. The bacteria then multiply beneath the surface of the

The development of a boil



A boil begins after bacteria called *staphylococci* enter the skin around a hair. The boil first appears as a hard, red lump.

The lump softens as white blood cells and blood serum fill the center of the boil and form pus. The white blood cells fight the bacteria.

The pus drains out after the skin on top of the boil becomes thin and breaks. After the pus has drained, the boil heals.

WORLD BOOK illustrations by Leonard E. Morgan

skin. The body produces white blood cells to fight the bacteria. The white blood cells—and blood serum—fill the center of the boil, forming pus.

Skin tissue sometimes absorbs the pus. But in the majority of cases, the skin that covers the top of the boil becomes thin and breaks, and the pus drains out. After the pus has drained out of the boil, the boil begins to heal.

Physicians treat boils by applying hot, moist pads and by prescribing antibiotics. In many cases, doctors drain the pus by cutting the skin over the boil. Only a physician should drain a boil because improper cutting may cause the infection to spread through the blood or to other areas of the skin.

A boil is contagious and should be covered with a bandage. Epidemics of boils sometimes result when infected people share towels or clothing with other people. In most cases, boils can be prevented by keeping the skin clean. Yelva Liptzin Lynfield

See also Abscess; Carbuncle; Sty.

Boileau-Despréaux, *bwah LOH day pray OH,* **Nicolas,** *nee kaw LAH* (1636-1711), was a French poet and critic of the Classical Age. His book of literary criticism, *The Art of Poetry* (1674), influenced French and English literature during the 1700's. Boileau wrote the book in the form of elegant *couplets* (groups of two related lines of rhymed poetry). In it, he defined great writing as lively, clear, imaginative, stylistically pure, and providing a deep emotional impact. Boileau wrote about life and literature of his time in 12 *Satires* (1666-1711) and 12 *Epistles* (1668-1698).

Boileau was born in Paris and spent most of his life there. He was a favorite of King Louis XIV. Boileau and a friend, playwright Jean Racine, were appointed royal historians in 1677. Robert B. Griffin

Boiler is a metal container in which a liquid is heated and changed into a vapor. Most boilers change water into the vapor steam. Steam is used to heat buildings. It changes from vapor to liquid form as it delivers heat, giving off even more heat as a result. Some heating systems, called *hydronic systems,* circulate hot water rather than steam. However, the heat source in such systems is still referred to as a boiler. Steam produced in boilers is also used to drive devices that produce electric power.

In one type of boiler, called the *fire-tube* boiler, gases flow through tubes surrounded by water. This type of boiler is used in most steam locomotives, in small factories, and in some homes. All high-pressure and large boilers are *water-tube* boilers. In these boilers, gases flow over water-filled tubes. Both ends of the tubes are connected to large containers called *drums.* The small tubes in the water-tube boiler can withstand high pressure better than the large vessels of a fire-tube boiler. The steam generated in the tubes of a water-tube boiler collects at the top of a drum. It usually flows through a set of tubes called a *superheater.* The hot gases flow over the steam-filled tubes, increasing the temperature of the vapor. The combination of a boiler and a superheater is often called a *steam generator.*

Boilers must be strong enough to hold the high pressures inside them without bursting. They are built carefully and tested before they are used. The pressure inside a boiler is measured in pounds per square inch or *kilopascals* (kilograms per square centimeter). Every boiler is marked with the pressure it can safely withstand. A gauge shows the pressure in the boiler. Law requires each boiler to have a *safety valve.* When the pressure reaches the danger point, the steam opens the valve and flows out into the air (see Safety valve).

Most boilers used in homes have operating pressures of 10 to 15 pounds per square inch (70 to 105 kilopascals). Huge boilers used in electric power stations have operating pressures of about 3,500 pounds per square inch (24,100 kilopascals).

Some impurities found in water can cause corrosion and weaken a boiler. Others cause a layer of solid *scale* to form inside the boiler tubes. The scale reduces the transfer of heat through the tube so that the tube metal becomes overheated. Care must be taken to remove air and other dissolved substances from water supplied to the boiler. Water softeners added to the water react chemically with substances already in the water to prevent scale (see **Water softening**). Evan Powell

Related articles in *World Book* include:
Furnace
Heating
Locomotive (Steam locomotives)
Steam engine
Turbine (Steam turbines)

Boiling point is the temperature at which a liquid bubbles and changes into vapor. At this temperature, the *vapor pressure* (the pressure exerted by the vapor) equals the atmospheric pressure. The motion of vapor molecules produces the vapor pressure, which rises as the temperature of the liquid rises. The lower the atmospheric pressure is, the lower is the temperature needed to produce a vapor pressure equal to the atmospheric pressure. So the boiling point of any substance depends on the atmospheric pressure.

Unless otherwise specified, boiling points are based on a pressure of *1 atmosphere* (14.696 pounds per square inch [101.325 kilopascals]), the average pressure of the atmosphere at sea level. As altitude increases, atmospheric pressure decreases. Thus, the boiling point of a substance also decreases as the altitude increases. The boiling point of water at sea level is 100 °C (212 °F). But at 10,000 feet (3,050 meters) above sea level, water boils at about 90 °C (194 °F).

How pressure affects boiling. If a liquid is put into a closed vessel, leaving space above the liquid, some of the liquid turns into vapor. The pressure produced by the vapor is the liquid's vapor pressure. The vapor pressure stabilizes when it equals the pressure of the liquid.

If the vessel is opened and the atmospheric pressure exceeds the vapor pressure, nothing noticeable happens to the liquid. The pressure of the air holds the liquid's vapor above the liquid, maintaining a fairly stable vapor pressure. But if the atmospheric pressure equals or is less than the vapor pressure, the liquid boils. In boiling, bubbles of vapor form in the liquid and rise to the surface. The vapor then pushes out against the air and escapes from the space above the liquid. Because the vapor escapes, its pressure never stabilizes, and the liquid evaporates completely.

A liquid does not have to reach its boiling point to evaporate completely. This fact can be demonstrated by placing a pan of cool water in the sun on a hot day. The atmospheric pressure exceeds the vapor pressure, and so the water vapor becomes trapped above the water. If

air currents sweep vapor molecules away, more water turns into vapor and evaporation continues. As a result, the water in the pan soon dries up.

Why boiling points differ. Substances have different boiling points because they vary in the strength of the bonds between their molecules. The stronger the forces of attraction between the molecules of a substance, the lower the vapor pressure of the substance at a given temperature. In turn, the lower the vapor pressure of a substance, the higher its boiling point. For example, water molecules are strongly attracted to one another. Water thus has a fairly low vapor pressure, and it boils at 100 °C. Nitrogen, whose molecules are not as strongly held together as water molecules, has a higher vapor pressure and a much lower boiling point, −195.8 °C.

Some substances have especially strong bonds between molecules and almost no vapor pressure at ordinary temperatures. These substances boil only at extremely high temperatures. For example, gold turns into liquid at 1064.43 °C and has a boiling point of 2807 °C. The boiling point of iron, which becomes liquid at 1535 °C, is 2750 °C. John P. Chesick

See also **Gas** (How gases behave); **Pressure**; **Steam**; **Temperature**; **Vapor**.

Bois d'arc. See **Osage orange**.

Boise, *BOY zee* or *BOY see* (pop. 185,787; met. area pop. 432,345), is the capital and largest city of Idaho. It lies in the southwestern part of the state (see **Idaho** [political map]). It was named for the Boise River, which flows through it. *Boise* comes from the French word *bois,* which means *wooded.* French-Canadian fur trappers came to the area in the early 1800's. They gave the river its name because of the many trees along its banks. Boise is often called the *City of Trees.*

Boise, the county seat of Ada County, covers 54 square miles (140 square kilometers). Its metropolitan area consists of Ada and Canyon counties. The city has a mayor-council government. It lies in a fertile valley, and the Boise Front Mountains rise just to the north. About 6,500 people of Basque descent live in the Boise area. Hundreds of Basques from northern Spain settled in Idaho during the late 1800's. Many had raised sheep in their homeland and had heard of Idaho's plentiful grazing land and its sheep industry. Boise became the chief center of the Basques in the United States. See **Basques**.

More than 60 federal agencies maintain regional offices in Boise, and government—federal, state, and local—is the city's largest employer. Several major corporations have their headquarters in Boise. They include manufacturers of computer microchips and companies in the construction, food processing, and forest products industries. The production of electronic equipment is Boise's largest industry. Factories in the Boise area also produce mobile homes, laminated beams, metal products, farm commodities, and paints.

Cultural attractions include the Boise Art Museum, the Boise City Zoo, the Idaho Historical Museum, the Boise Philharmonic Orchestra, and the Boise Opera. Boise State University is in the city. The Boise River Greenbelt, a system of parks along the river, extends more than 20 miles (32 kilometers) through Ada County.

Indians, among them the Shoshone and Paiute tribes, lived in the Boise area before white settlers arrived. Gold was discovered in the nearby mountains in 1862, and miners poured into the area. On July 4, 1863, the Army set up Fort Boise to protect the miners from Indian raids. The town was laid out a few days later. It became the capital of the Idaho Territory in 1864.

At first, Boise was a distribution center for miners' supplies. In the late 1800's, the community's economy shifted to agriculture as farmers started to irrigate land along the Boise River. The city's population grew from about 6,000 in 1900 to over 17,000 in 1910.

By 1960, Boise had about 34,000 people. The population more than doubled when the city annexed suburban areas in the 1960's, and growth has continued. Construction of tall bank and hotel buildings in the 1980's and 1990's changed Boise's skyline. Old storefronts and a railroad depot remain as landmarks. Todd Shallat

See also **Idaho** (Climate; pictures).

Boito, *BOH ee toh* or *BOY taw,* **Arrigo,** *ahr REE goh* (1842-1918), was an Italian composer, author, and poet. He was an aristocratic scholar who greatly influenced Italian music of his time. However, he completed only one opera, *Mefistofele* (1868), a work based on the story of Faust, a scholar who sells his soul to the devil, Mefistofele. From 1862 until he died, Boito worked on *Nerone,* an opera produced in 1924 after his death.

Boito wrote *librettos* (words) for his own operas and for those of other composers. His most notable librettos were for Amilcare Ponchielli's *La Gioconda* (1876) and for two operas by Giuseppe Verdi, *Otello* (1887) and *Falstaff* (1893). Boito also wrote novels, essays, and poetry, and translated librettos into Italian. Much of his verse deals with romantic medieval subjects. Boito was born on Feb. 24, 1842, in Padua. Charles H. Webb

Bola. See **Sling**.

Bolero, *buh LAIR oh* or *boh LAY roh,* was originally a Spanish folk dance. It was first performed in theaters about 1780 and became a social dance in Cuba by the early 1800's. The term *bolero* is also used for the music that accompanies the dance.

The bolero is usually performed to music in moderate $\frac{3}{4}$ time, but some Cuban versions are in slow $\frac{2}{4}$ time. It can be a solo or couple dance, and has many steps and figures. In solo form, the bolero combines intricate steps, pauses, and light foot stampings with high jumps and leaps. Couples perform the dance in three sections. The partners dance together in the first and third sections and perform solo in the middle section. Dancers usually sing and play castanets. Guitars and tambourines accompany in the background.

Several classical composers have written boleros, including Ludwig van Beethoven, Frédéric Chopin, and Maurice Ravel. The best-known bolero is Ravel's music for the one-act ballet *Boléro* (1928). Patricia W. Rader

Boleyn, *BUL ihn* or *bu LIHN,* **Anne** (1507?-1536), was the second, and most famous, of King Henry VIII's six wives. Henry's determination to marry her led to the separation of the Church of England from the Roman Catholic Church. The princess she bore the king became Queen Elizabeth I.

Anne was a maid of honor to Catherine of Aragon, the first wife of Henry VIII, when the king became interested in her. Pope Clement VII resisted Henry's request to *annul* (declare invalid) Henry's marriage to Catherine. In spite of the pope's refusal, Henry secretly married Anne in January 1533, after she became pregnant. A church

court presided over by the archbishop of Canterbury, Thomas Cranmer, then declared Henry's first marriage invalid. Anne Boleyn was crowned queen in June. In September, she gave birth to Elizabeth. Parliament, at the king's bidding, broke with the Catholic Church in 1534 and established Henry as supreme head of the Church of England.

Detail of oil portrait by an unknown artist, National Portrait Gallery, London

Anne Boleyn

Anne's marriage to Henry did not last long. They failed to have the son that Henry thought he needed to assure a peaceful succession to the throne after he died. The king quickly lost interest in Anne, who had become proud, spiteful, and unpopular. She was condemned on a charge of unfaithfulness and beheaded on May 19, 1536. Richard L. Greaves

See also **Henry VIII.**

Additional resources

Ives, Eric W. *Anne Boleyn.* Basil Blackwell, 1986.
Warnicke, Retha M. *The Rise and Fall of Anne Boleyn.* 1989. Reprint. Cambridge, 1991.

Bolger, Jim (1935-), served as prime minister of New Zealand from 1990 to 1997. In 1990 and 1993, he led the National Party to victory in parliamentary elections. In a general election held in 1996, the National Party won the most seats in Parliament but not a majority. It formed a *coalition* (alliance) with the New Zealand First party, and Bolger remained prime minister. In late 1997, he was replaced as leader of the National Party and as prime minister by Jenny Shipley.

Bolger continued the liberalization and privatization economic policies begun by the Labour Party in the 1980's. He also reduced welfare benefits and lessened government regulation of relations between employers and labor unions.

James Brendan Bolger was born in the Taranaki region of western North Island and became a sheep and cattle farmer. He was first elected to Parliament in 1972. In 1977, Prime Minister Robert D. Muldoon named Bolger minister of fisheries and associate minister of agriculture. From 1978 to 1984, Bolger served as minister of labor, and from 1978 to 1981, he was minister of immigration. He became deputy leader of the National Party in 1984 and party leader in 1986. Elizabeth McLeay

Bolívar, *BAHL uh vuhr* or *boh LEE vahr,* **Simón,** *SY muhn* or *see MAWN* (1783-1830), was one of South America's greatest generals. His victories over the Spaniards won independence for Bolivia, Colombia, Ecuador, Peru, and Venezuela. Bolívar is called *El Libertador* (The Liberator) and the "George Washington of South America."

Early life. Bolívar was born in Caracas, Venezuela. His parents died when he was a child, and he inherited a fortune. As a young man, he traveled in Europe and married a daughter of a Caracas-born nobleman. She died less than a year after their return to Caracas. Grief-stricken, Bolívar again toured Europe, and while in Rome made a vow to liberate Venezuela.

Fight for freedom. On his return to Venezuela, Bolívar joined the group of patriots that seized Caracas in 1810 and proclaimed an independent government. He went to Britain in search of aid but could only get a promise of British neutrality. Then he returned to Venezuela and took command of a patriot army. He recaptured Caracas in 1813 from the Spaniards, who had regained control of Venezuela after Francisco de Miranda's surrender (see **Miranda, Francisco de**). Bolívar became dictator of the country.

Detail of an oil portrait (1824) by José Gil de Castro; Alfredo Boulton Collection, Los Guayabitos Caracas, Venezuela (Organization of American States, Washington, D.C.)

Simón Bolívar

The Spaniards forced Bolívar to retreat from Venezuela to the territory that later became Colombia. He took command of a Colombian force and captured Bogotá in 1814. But new defeats led him to flee to Jamaica. In Haiti, he gathered a force that landed in Venezuela in 1816 and captured Angostura (now Ciudad Bolívar). He then became the dictator there.

His victories. Bolívar marched south in 1819. He defeated the Spaniards at Boyacá in 1819, liberating the territory of Colombia. He then returned to Angostura and led the congress that organized the republic of Gran Colombia. At first, Gran Colombia included what are now Colombia and Venezuela. Panama joined the republic in 1821, and Ecuador joined it in 1822. Bolívar became its first president on Dec. 17, 1819.

Bolívar crushed the Spanish army at Carabobo in Venezuela on June 24, 1821. Next, he marched into Ecuador and added that territory to the new Colombian republic. Bolívar became dictator of Peru in 1824.

Under the leadership of General Antonio José de Sucre, Bolívar's army won a victory over the Spaniards at Ayacucho in 1824, which ended Spanish power in South America. Upper Peru became a separate state, named Bolivia in Bolívar's honor, in 1825. The constitution that he drew up for Bolivia is one of his most important political pronouncements.

Bolívar hoped to form a union of the new South American nations against Spain, and to establish close relations between these nations and Britain. But the achievement fell short of his hopes. By 1830, the republic of Gran Colombia had split into three separate countries—Colombia (including Panama), Ecuador, and Venezuela. Feeling against Bolívar grew strong. He narrowly escaped assassination in Bogotá. He resigned as president of Colombia in 1830. Helen Delpar

See also **Peru** (The War of Independence); **Venezuela** (History); **Latin America** (The wars of independence; picture); **Flag** (picture: Historical flags of the world).

Additional resources

De Varona, Frank. *Simón Bolívar.* Millbrook, 1993. Younger readers.
Greene, Carol. *Simón Bolívar.* Childrens Pr., 1989. Younger readers.
Masur, Gerhard. *Simon Bolivar.* Rev. ed. Univ. of N. Mex. Pr., 1969. A classic biography.

© Thomas B. Hollyman, Photo Researchers

The way of life in rural Bolivia has changed little over the centuries. These farmers, who are tending a flock of llamas, live much as their ancestors did hundreds of years ago. About 40 percent of all Bolivian workers are farmers. Most of them must struggle to make a living.

Bolivia

Bolivia, *boh LIHV ee uh* or *buh LIHV ee uh*, is a country near the center of South America. It lacks a seacoast and has great natural barriers to transportation. In western Bolivia, the majestic, snow-capped Andes Mountains surround a high, dry plateau. A vast lowland plain spreads over the north and east. Tropical rain forests thrive in the northern part of the plain, and grasslands and swamps sprawl across much of the east. Largely hilly country lies between the Andes Mountains and the lowland plain.

Most Bolivians are of Indian or of mixed Spanish and Indian ancestry. About half the country's workers farm for a living. Most Bolivians are desperately poor, and many adults cannot read and write.

Bolivia has two capitals. Sucre, where the Supreme Court meets, is the official capital. However, most government offices are in La Paz, the actual capital and Bolivia's largest city.

Bolivia is rich in natural resources and is a leading producer of tin. However, frequent wars, revolutions, and a series of unstable governments have hampered the country's economic growth. As a result, Bolivia remains a developing country with one of the lowest standards of living in the Western Hemisphere.

American Indians were the first people to live in what is now Bolivia. During the 1500's, Spain conquered the Indians. The Spanish ruled the region until 1825, when Bolivia won its independence. The new country was named after Simón Bolívar. Bolívar, a Venezuelan general, helped Bolivia and several other South American countries win their freedom from Spain.

J. H. Galloway, the contributor of this article, is Professor of Geography at the University of Toronto.

Government

National government. Bolivia has had 16 constitutions since it became independent in 1825. Most of the constitutions called for a freely elected government. However, dictators have often ruled the country.

Bolivia's present Constitution dates from 1967. Under it, the people elect a president and the members of the national legislature, called Congress, to four-year terms. The president may not be elected to two terms in a row. The Supreme Court is Bolivia's highest court. Congress appoints the court's justices.

Facts in brief

Capital: Sucre (official); La Paz (actual).
Official languages: Spanish, Aymara, and Quechua.
Official name: República de Bolivia (Republic of Bolivia).
Area: 424,165 mi² (1,098,581 km²). *Greatest distances*—north-south, 900 mi (1,448 km); east-west, 800 mi (1,287 km).
Elevation: *Highest*—Nevado Sajama, 21,463 ft (6,542 m) above sea level. *Lowest*—300 ft (90 m) above sea level, near Fortaleza.
Population: *Estimated 2002 population*—8,691,000; density, 20 per mi² (8 per km²); distribution, 62 percent urban, 38 percent rural. *1992 census*—6,420,792.
Chief products: *Agriculture*—coca, sugar, potatoes, corn, rice, wheat, coffee, cotton. *Forest products*—timber, rubber. *Manufacturing and processing*—refined tin, processed foods, textiles. *Mining*—tin, natural gas, petroleum, zinc, lead, antimony, tungsten, copper, silver, gold.
Money: *Basic unit*—boliviano. One hundred centavos equal one boliviano.

Local government. Bolivia is divided into 9 departments for purposes of local government. The departments are divided into 94 provinces, which are further divided into 1,272 cantons. Appointed officials govern all the political units. In general, they have little independence from the national government.

Politics. Bolivia has many political parties. Miners' unions and the military have great influence on the nation's politics. Married Bolivians who are at least 18 years of age may vote. Unmarried Bolivians must be at least 21 years old to vote.

The armed forces. Bolivia has an army of about 30,000 members. It also has a small navy, which maintains patrol boats on inland waters, and a small air force. All Bolivian men age 18 or older may be drafted.

People

Population and ancestry. As Bolivia's population has grown, more of its people reside in urban areas. Well over half of all Bolivians now live in cities or towns. Over one million people live in or around La Paz.

American Indians have lived in what is now Bolivia for thousands of years. During the 1500's, Spain began to colonize the area. Through the years, many Spaniards and Indians intermarried. Today, *mestizos* (people of mixed white and Indian ancestry) make up about 30 percent of the population. About 60 percent of the people are of unmixed Indian ancestry. Most of the rest of the population are people of unmixed white ancestry.

Language. Bolivia has three official languages—Spanish and the Indian languages of Aymara and Quechua. About one-third of the people speak Spanish. Most Bolivians speak an Indian language. Aymara and Quechua are the most common Indian languages.

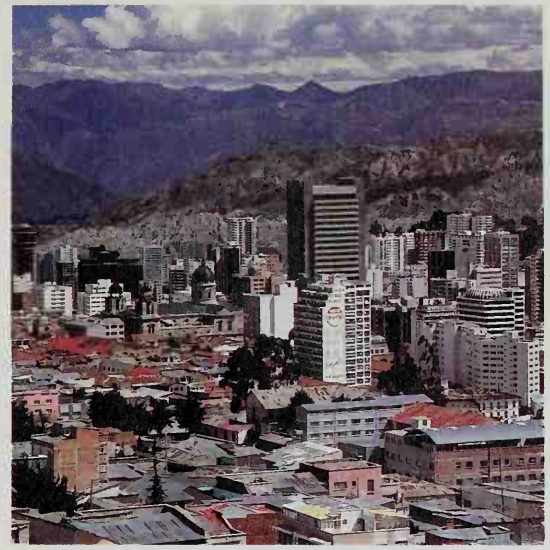
Way of life. Many Latin-American countries have long had strict class systems based on ancestry. In Bolivia, however, generations of intermarriage have made it difficult to define the classes according to ancestry. Large numbers of mestizos belong to all classes.

Wealthy Bolivians, called the *elite*, form the nation's smallest social class. The elite speak Spanish and live in modern city apartments or in elegant Spanish-style houses with patios. Most elite families have had their wealth for generations, and some of them own large amounts of land.

Bolivia's middle class includes government officials and doctors, lawyers, and other professionals. The life of the middle class in Bolivia resembles that of the elite but is much less luxurious.

Working-class Bolivians include peddlers, factory workers, and farmers who raise crops chiefly to sell. Many working-class Bolivians, called *cholos*, follow a mixture of Spanish and Indian traditions. They speak Spanish and one or more Indian languages. The typical cholo house is made of adobe and has a tile or metal roof. In the cities, most cholos live in crowded neighborhoods called *barrios*.

Poor farmers, called campesinos, make up Bolivia's largest social class. Campesinos follow Indian customs and speak Indian languages. They farm small plots, and most of them raise barely enough food to live on. Many of the women weave textiles or make pottery to earn extra money. Most campesinos live in tiny adobe houses with thatch roofs.



© Eberhard E. Otto, FPG

La Paz, Bolivia's largest city, lies on a cool plateau high in the Andes Mountains. La Paz serves as the nation's actual capital, though Sucre is the official capital.

Bolivia's state flag, used only by the government, was adopted in 1888. The national flag, flown by the people, is the same as the state flag but has no coat of arms.

The coat of arms shows a breadfruit tree, a bundle of wheat, and a mountain in Bolivia famous for silver mines. The coat of arms also shows a condor and an alpaca.

WORLD BOOK map

Bolivia lies near the center of South America. It is bordered by Brazil, Paraguay, Argentina, Chile, and Peru.

Clothing. Most wealthy and middle-class Bolivians dress much like the people in the United States and Canada. Some cholos also wear Western-style clothing. However, many cholos and most campesinos wear traditional costumes. Such costumes include striped ponchos for men and colorful shawls and full skirts for women. Many women also wear derby hats.

Food. Traditional foods in Bolivia include potatoes, corn, and a grain called *quinoa*. Bolivians often cook *chuño*, a dried form of potato, in stews or porridges. Some other common dishes include corn-filled pies called *humitas* and meat turnovers called *salteñas*.

Most poor Bolivians have an inadequate diet. Many of them chew the leaves of the coca plant to relieve hunger and fatigue. Coca leaves contain cocaine and other drugs.

Religion. About 95 per cent of all Bolivians are baptized Roman Catholic. Most of them take part in church festivals, but few attend Mass regularly. In addition, many Catholics continue to honor traditional Indian gods and goddesses. Most other Bolivians still hold various Indian religious beliefs.

Departments*

Beni	282,631	C	3
Chuquisaca	496,781	E	3
Cochabamba	1,073,539	D	2
La Paz	2,134,008	D	1
Oruro	437,324	D	2
Pando	55,251	A	1
Potosí	841,156	E	2
Santa Cruz	1,314,585	D	3
Tarija	293,224	F	3

Cities and towns

Achacachi	4,162	C	1
Aiquile	4,901	D	3
Anzaldo*	711	D	2
Apolo	1,273	C	1
Atocha	4,677	F	2
Azurduy	930	E	3
Bermejo	13,022	F	3
Calacala*	5,180	D	2
Camiri	19,782	E	3
Capinota	2,646	D	2
Caracollo	1,708	D	2
Catavi	7,593	D	2
Challapata	4,056	E	2
Chaqui	824	E	3
Chayanta*	2,937	D	2
Chojlla*	4,547	C	2
Cliza*	3,908	D	2
Cobija	3,636	A	1
Cochabamba	403,600	D	2
Colquiri	15,334	D	2
Copacabana	2,919	C	1
Corocoro	6,271	D	1
Coroico	1,656	C	2
Entre Rios	1,592	F	3
Fortaleza	810	A	2
General Saavedra	8,918	D	3*
Guayaramerin	12,504	A	2
Huanuni	17,292	D	2
La Paz	976,800	D	1
Llallagua	23,361	D	2
Mineros	6,184	D	3
Montero	28,647	D	3
Nazareno*	823	F	2
Oruro	176,700	D	2
Padilla	2,510	E	3
Portachuelo	7,016	D	3
Porvenir	501	A	1
Potosí	110,700	E	2
Pucarani*	712	D	1
Puerto Rico	250	A	2
Punata	10,216	D	2
Quillacollo	19,433	D	2
Riberalta	18,032	A	2
Reboré	6,790	D	5
Reyes	3,177	C	2
Sacaba	5,728	D	2
Sacaca*	1,367	D	2
San Borja	4,613	C	2
San Ignacio	2,998	C	2
San Joaquin	1,978	B	3
San Lucas	690	E	3
Santa Ana	1,334	B	2
Santa Cruz	529,200	D	3
Sicasica	1,660	D	2
Siglo Veinte	10,766	D	2
Sorata*	1,904	C	1
Sucre	105,800	E	3
Tarabuco	2,337	E	3
Tarija	54,001	F	3
Toledo*	970	D	2
Totora	1,789	D	3
Trinidad	27,583	C	3
Tupiza	10,682	F	2
Uncia	7,396	E	2
Uyuni	8,639	E	2
Vallegrande	5,243	D	3
Viacha	9,766	D	1
Villa Talavera	1,248	E	2
Villamontes	6,629	F	3
Villazón	12,536	F	3
Vinto	4,419	D	2
Vitichi	883	E	2
Warnes	4,594	D	3
Yacuiba	10,791	F	3
Zudáñez	1,213	E	3

WORLD BOOK map

Physical features

Abuná River	A	2	
Altiplano (plateau)	D	1	
Andes Mountains	D	1	
Bañadas del Izozog (swamp)	E	4	
Baures River	B	3	
Beni River	B	2	
Cordillera Central (mountains)	E	3	
Cordillera Real (mountains)	C	1	
Desaguadero River	D	1	
Guaporé River	B	3	
Illampu (mountain)	C	1	
Illimani (mountain)	D	2	
Lake Colpasa	E	1	
Lake Concepción	D	4	
Lake Poopó	E	2	
Lake Titicaca	C	1	
Madidi River	B	1	
Madre de Dios River	A	2	
Mamoré River	C	3	
Nevado Sajama (mountain)	D	1	
Parapeti River	E	3	
Pilcomayo River	E	3	
Salar de Uyuni (salt flat)	E	1	
Valles (valleys)	F	3	
Yungas (valleys)	C	2	

*Not on map; key shows general location.
Sources: 1989 official estimates for departments and largest cities; 1976 census for all other places.

Recreation. Colorful festivals play an important role in the life of Bolivians. The festivals feature parades, feasts, and elaborate dances. The festival dancers wear brightly colored costumes and masks. Most festivals celebrate national holidays or honor Catholic saints or Indian gods and goddesses.

Soccer is Bolivia's favorite sport. In the large cities, professional teams play before huge crowds.

Education. Most Bolivians 15 years of age or older can read and write. For the country's literacy rate, see Literacy (table: Literacy rates for selected countries).

Bolivia provides free elementary and high school education. Children from ages 6 through 13 must attend school. However, many drop out before the age of 13. An especially large number of campesino children leave school to help their families farm the land.

Bolivia has 10 universities. The University of St. Francis Xavier in Sucre is one of the oldest universities in South America. It was founded in 1624.

The arts. For thousands of years, the Indians of Bolivia have made fine jewelry, pottery, and colorful rugs and shawls. The Tiahuanaco Indians, who lived near Lake Titicaca from about 100 to 1200 A.D., produced impressive statues and monuments.

The Spanish colonists in Bolivia built many beautiful stone churches during the 1500's and 1600's. Indian craftworkers, hired by the Spanish, carved bold designs into the outside walls of the churches.

During the 1900's, social injustice and the everyday activities of the Indians provided the themes for many Bolivian writers and artists. For example, Augusto Céspedes examined the mistreatment of Indian tin miners in his novel *Metal del Diablo* (1946). Marina Núñez del Prado won fame for her sculptures depicting Indian life.

The land

Bolivia has four major land regions. They are (1) the Andean Highlands, (2) the Yungas, (3) the Valles, and (4) the Oriente. Some geographers classify the Valles as a subregion of the Yungas.

The Andean Highlands cover much of western Bolivia. A high plateau called the Altiplano lies between two craggy ranges of the Andes Mountains. The western range forms part of Bolivia's western border. The eastern range divides the Altiplano from the rest of the country. About 40 percent of Bolivia's people live on the Altiplano, many of them in La Paz.

Few trees grow on the Altiplano. The southern section is especially barren. The world's highest navigable lake, Lake Titicaca, is partly in the northern Altiplano and partly in Peru. The lake lies at an altitude of 12,507 feet (3,812 meters) above sea level. Small farms dot the land near Lake Titicaca.

The Yungas make up a small region northeast of the Andean Highlands. The region has steep hills and narrow gorges. Subtropical forests thrive on the hillsides. Few people live in the Yungas.

The Valles lie in south-central Bolivia. The region consists of gently sloping hills and broad valleys. Open grasslands and many farms cover the land. The Valles produce much of the nation's food.

The Oriente is a vast lowland plain that spreads across northern and eastern Bolivia. Tropical rain forests flourish in the north. Open grasslands, swamps, and shrubby forests cover much of the rest of the Oriente. Many large farms lie near Santa Cruz. Most of the region has few inhabitants.

© W. Fischer, FPG

Lake Titicaca, on the Bolivian-Peruvian border, is the world's highest navigable lake at 12,507 feet (3,812 meters) above sea level. Reed boats are used on the lake.

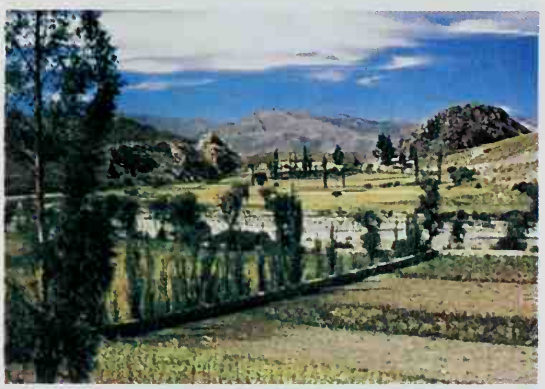
Wide, sluggish rivers flow through the Oriente. After a heavy rainfall, numerous rivers overflow their banks and flood the surrounding area. Many of the rivers form part of the Amazon River system.

Climate

The climate in Bolivia varies greatly from region to region. Bolivia lies south of the equator, and so its seasons are opposite those of the Northern Hemisphere. In the Andes Mountains, snow covers the highest peaks the year around. The Altiplano has sparkling clear air and a cool, dry climate. The temperature averages 55 °F (13.1 °C) in January and 40 °F (4.4 °C) in July.

The Yungas have a warm, humid climate. Heavy mists often surround the region's highest hills. The climate in the Valles is like that of the Yungas, but it is much less humid. The temperature in both the Yungas and the Valles regions averages about 72 °F. (22 °C) in January and 52 °F. (10.9 °C) in July.

Most of the Oriente has a hot, humid climate. The



Chip and Rosa Maria Peterson

The Valles, a region in south-central Bolivia, consist of gently sloping hills and broad, fertile valleys. The region has numerous farms, which produce much of the nation's food.

daily temperature averages 75 °F (24 °C) the year around. However, the temperature drops suddenly when cool, dust-laden winds called the *surazos* blow northward across the Oriente during the winter months.

The rainy season in most parts of Bolivia lasts from December through February. The Oriente receives the most rain. Light rain falls on the Altiplano, and droughts frequently trouble the region.

Economy

Bolivia is a developing country. However, it has a wealth of natural resources that are not being fully used and which could provide for economic growth. These resources include plentiful minerals, pastureland, timber, and fertile soil.

Service industries and agriculture account for most of Bolivia's *gross domestic product* (GDP)—that is, the total value of all goods and services produced yearly. Bolivia's economy is based on private enterprise. But the government controls mining and some other basic industries.

Service industries account for about 38 percent of Bolivia's GDP and employ about 40 percent of the country's workers. The service industries include businesses, government agencies, hospitals, and schools.

Agriculture accounts for about 32 percent of Bolivia's GDP and employs about 47 percent of all workers. Farmers on the Altiplano grow potatoes, wheat, and a grain called *quinoa*. They raise llamas and alpacas for their wool. The Yungas and the Valles regions yield bananas, beans, cacao, coffee, and corn. Another important crop of the Yungas is *coca*, from which the drug cocaine is made. Bolivia is one of the world's leading producers of coca. In the Oriente, farmers raise cattle and grow cotton, rice, and sugar cane.

Manufacturing accounts for about 17 percent of Bolivia's GDP and employs about 7 percent of all workers. Bolivian factories refine tin, process foods, and make textiles and other products. The chief industrial centers are La Paz, Santa Cruz, and Cochabamba.

Mining accounts for about 13 percent of Bolivia's GDP and employs about 3 percent of all workers. Tin is Bolivia's most important mineral, but it is declining in significance. However, the nation still ranks among the world's leading tin producers. Metal deposits lie high in the Andes Mountains. Besides tin, these deposits include antimony, copper, lead, silver, tungsten, and zinc. The Oriente yields gold, petroleum, and natural gas.

© Victor Englebert

Tin mining is a major industry in Bolivia, and the country ranks as one of the world's leading tin producers. The men above are working in an underground tin mine in the Andes Mountains.

Energy sources. Petroleum supplies about 70 percent of the energy used in Bolivia. Most of the petroleum comes from the Oriente. Other important sources of energy include natural gas and hydroelectricity.

Trade. Natural gas is Bolivia's chief legal export. But authorities believe that the illegal export of coca brings in much more money. Bolivia also exports antimony, gold, silver, tin, tungsten, coffee, lumber, sugar, and rubber. Imports include heavy machinery, transportation equipment, and such consumer goods as clothing, food, and household items. Bolivia trades mainly with the United States, Argentina, and Western European countries.

Transportation and communication. Bolivia's rugged terrain and dense forests have made it difficult to build roads and railroads. The country has only about 800 miles (1,300 kilometers) of paved road and about 2,300 miles (3,700 kilometers) of railroad track. Bolivia has an average of about 1 automobile for every 150 people. The nation has international airports at La Paz, Cochabamba, and Santa Cruz.

Bolivia publishes about 15 daily newspapers. The country has an average of about 1 radio for every 2 people and 1 television set for every 10 people. Telephone and telegraph systems link the major cities.

History

American Indians lived in what is now Bolivia as long as 10,000 years ago. About A.D. 100, a major Indian civilization developed in the Tiahuanaco region near Lake Titicaca. The Tiwanaku (Tiahuanaco) Indians built huge monuments and carved stone statues. Their civilization declined rapidly during the 1200's. By the late 1300's, a warlike tribe called the Aymara controlled much of western Bolivia. The Inca Indians of Peru defeated the Aymara during the 1400's and made Bolivia part of their huge empire. The Inca forced their religion, customs, and language, Quechua, on the Bolivian Indians.

Colonial rule. During the 1530's, Spain conquered the Inca and made Bolivia a Spanish colony called Upper Peru or Charcas. Spanish colonists soon began to settle in Bolivia and establish large estates called *haciendas*. After silver was discovered in the mountains near Potosí in 1545, Spaniards poured into Bolivia by the thousands. Bolivia's silver became an important source of wealth for Spain.

The Spanish colonists frequently mistreated the Indians of Bolivia. They forced the Indians to work on the haciendas and in the silver mines. Many Indians died of mistreatment or of diseases brought by the Spaniards. Some Spaniards and Indians intermarried, producing the beginning of a mestizo population. From time to time, the Indians and mestizos rebelled against the Spanish. Most of the rebellions were quickly crushed.

Independence. Spain's colonies in Latin America gradually became increasingly dissatisfied with Spanish rule. During the early 1800's, the Venezuelan general Simón Bolívar organized an army to fight for the inde-

pendence of Spain's South American colonies. In 1824, Bolívar sent one of his generals, Antonio José de Sucre, to free Bolivia. Sucre's forces defeated the Spanish in 1825, and Bolivia declared its independence. The new nation was named after Bolívar. In 1826, Sucre became the first constitutional president. He governed Bolivia until 1828. In 1829, Andrés Santa Cruz, another of Bolívar's generals, became president. Under him, Bolivia enjoyed a period of relative prosperity and political stability. Santa Cruz was overthrown in 1839.

Dictators ruled Bolivia until the late 1800's. Most of the dictators took little interest in Bolivia's progress. Instead, their chief concern was to remain in power.

Territorial losses. Over the years, Bolivia lost more than half its territory. The losses resulted from war or treaties with Argentina, Brazil, Chile, Paraguay, and Peru. One of the worst losses followed Bolivia's defeat in the War of the Pacific (1879-1883). In this war, Chile seized Bolivia's nitrate-rich land along the Pacific Ocean. Bolivia has been without a coastline ever since.

In the late 1800's, the world price of silver increased greatly and large deposits of tin were discovered in Bolivia. The export of these minerals became highly important to Bolivia's economy. Political parties representing the interests of the mine owners grew more and more powerful. They controlled Bolivia until the 1930's and helped the country achieve greater political stability. Bolivia's presidents during this time devoted much effort to promoting mining and the building of railroads.

Bolivia suffered another major territorial loss as a result of the Chaco War. The war broke out in 1932 between Bolivia and Paraguay over ownership of the Gran Chaco, a large lowland plain bordering the two countries. Bolivia was defeated in 1935. It gave up most of the disputed land under a settlement arranged in 1938.

The Revolution of 1952. Great political disorder followed Bolivia's defeat in the Chaco War. From 1936 to 1952, Bolivia had 10 presidents as one political leader after the other seized control of the government. Six of the presidents were military officers supported by the army. Meanwhile, Bolivia's tin miners formed unions and held strikes for better working conditions. The miners supported a political party called the National Revolutionary Movement, which backed their demands. In 1952, the Revolutionary Movement overthrew the military rulers then in power. Víctor Paz Estenssoro, an economist and party leader, became president.

Under Paz, the Bolivian government took over the largest tin mines. The government also broke up large estates and gave the land to Indian farmers. Paz served as president until 1956. Under the Constitution, he could not serve more than one term in a row. Another leader of the Revolutionary Movement, Hernán Siles Zuazo, was then elected president. He served until 1960.

Return to military rule. In 1960, Paz was again elected president. A military uprising forced him from office in 1964. From that year through the 1970's, control of the government changed hands repeatedly, mostly after revolts by rival military officers. The military governments violated civil rights. They permitted no opposition to their rule and imprisoned their enemies. In the mid-1960's, Ché Guevara, a Communist leader from Cuba, tried to stir up a revolt in Bolivia. Bolivian troops killed him in 1967. See Guevara, Ché.

Recent developments. In 1980, Bolivia held an election for a civilian government. But military leaders again seized control before the elected government could take office. Then, in 1982, the military allowed the return to civilian government. The Congress elected in 1980 chose Siles Zuazo as president. In the 1985, 1989, 1993, 1997, and 2002 presidential elections, no candidate won a majority of the popular vote. As a result, Congress chose the president following each election. Víctor Paz Estenssoro was chosen to serve again in 1985. Jaime Paz Zamora was chosen in 1989, Gonzalo Sánchez de Lozada in 1993, and Hugo Bánzer Suárez in 1997. Bánzer resigned in 2001, and Vice President Jorge Quiroga Ramírez served the rest of Bánzer's term. Sánchez de Lozada was again chosen as president in 2002.

Economic problems, such as periodic inflation, have hurt Bolivia's economy. In addition, droughts and floods have damaged harvests and created food shortages. Workers have repeatedly gone on strike to protest high prices, low wages, and food shortages. Since 1995, the government has sold portions of state-controlled industries to private investors. These industries included the airline, oil, gas, and mining industries. J. H. Galloway

Related articles in *World Book* include:

Andes Mountains
Bolivar, Simón
Clothing (picture: Traditional costumes)
Inca
Lake Titicaca
La Paz
Latin America
South America
Sucre
Sucre, Antonio José de

Outline

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Questions

How did Bolivia lose more than half its territory?
Who were the first people to live in what is now Bolivia?
What is Bolivia's chief legal export?
What reforms followed the Revolution of 1952 in Bolivia?
Why does Bolivia have few paved roads and railroads?
How did the Spanish colonists in Bolivia treat the Indians?
Which land region in Bolivia has frequent droughts?
Who are the *elite* of Bolivia? *Cholos*? *Campesinos*?
Why do many children in rural Bolivia drop out of school?
For whom is Bolivia named? Why?

Additional resources

Hudson, Rex A., and Hanratty, D. M., eds. *Bolivia: A Country Study.* 3rd ed. U.S. Government Printing Office, 1991.
Klein, Herbert S. *Bolivia: The Evolution of a Multi-Ethnic Society.* 2nd ed. Oxford, 1992.
Murphy, Alan. *Bolivia Handbook.* Passport Bks., 1997.
Schimmel, Karen. *Bolivia.* Chelsea Hse., 1999. Younger readers.

Böll, *buhl* or *buhrl,* **Heinrich** (1917-1985), a German author, won the 1972 Nobel Prize for literature. His writings express a commitment to peace and plead for compassion for the victims of war, oppression, and social injustice. Böll's works also attack abuses of political and economic power.

Böll dealt with the horrors of war, especially World War II (1939-1945), in his early short-story collection *Traveller, If You Come to Spa . . .* (1950) and his novel *Adam, Where Art Thou?* (1951). After Germany's economic recovery following World War II, Böll's fiction became increasingly critical of capitalist society and the negative effects of prosperity. His novels *Billiards at Half-Past Nine* (1959) and *The Clown* (1963) expose the materialism and opportunism he saw in the older generation of German society. *Group Portrait with Lady* (1971), perhaps his best novel, tells the story of a woman who becomes an outsider to middle-class society.

Böll was born in Cologne. He also wrote radio plays and political and literary essays. Werner Hoffmeister

Boll weevil is a small beetle that feeds inside the *bolls* (seed pods) of cotton plants. Native to Mexico and Central America, boll weevils spread north into Texas about 1890. Since then, they have spread into most cotton-growing areas of the United States. Boll weevils cause serious damage to United States cotton crops each year.

Brownish to black in color, the boll weevil is about $\frac{1}{4}$ inch (6 millimeters) long. It is one of a group called *snout beetles,* because of the long beaks or snouts with which they feed. The boll weevil's snout is about half as long as the rest of its body.

Grant Heilman

A boll weevil, *above,* uses its long snout to feed on a cotton *boll* (seed pod). Young boll weevils grow to adulthood inside cotton bolls, *below.*

© Harry Rogers, Photo Researchers

In winter, adult boll weevils live in trash in or near cotton fields. When buds appear on the cotton plants in spring, female boll weevils puncture them with their snouts. They lay eggs inside the buds, and the eggs soon hatch into wormlike grubs. The grubs feed inside the buds, usually causing them to fall off the plant. Continuing to feed, the grubs become adult boll weevils in about $2\frac{1}{2}$ or 3 weeks. They then eat their way out of the buds and attack other buds. Later in the season, they attack the bolls, where the females deposit more eggs. Several generations of boll weevils may be produced in a single season. Many insecticides are used to control boll weevils. Large fields are often sprayed with insecticides from airplanes. Scientists also have developed such techniques as baiting traps with chemical lures to control boll weevils.

The coming of the boll weevil to the United States caused great damage to cotton crops, yet it produced some good results, too. It forced many farmers to plant other crops, and to use some of their lands for raising cattle, hogs, and chickens. Many became more prosperous than when they raised only cotton.

Scientific classification. The boll weevil belongs to the weevil or snout beetle family, Curculionidae. It is *Anthonomus grandis.* W. Joe Lewis

See also **Cotton** (Care during growth); **Weevil.**

Bollworm. See **Corn earworm.**

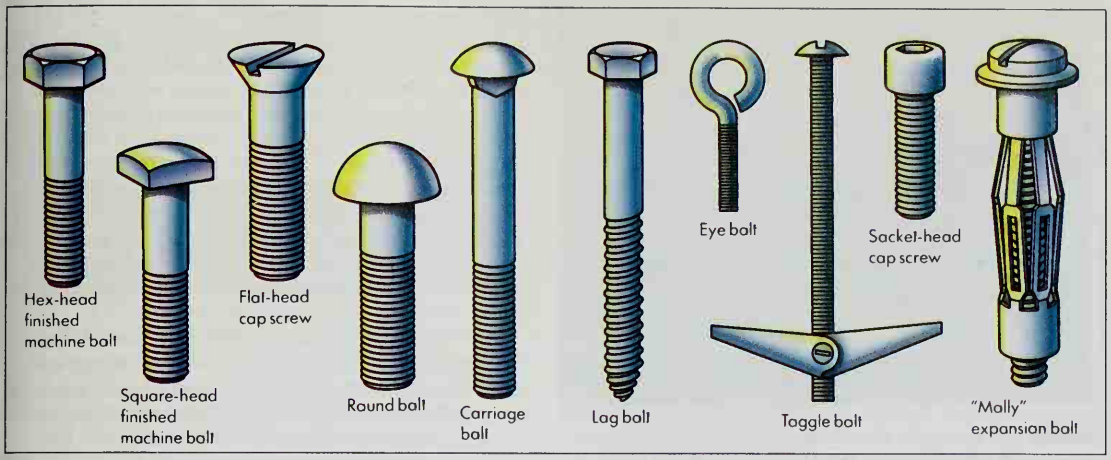
Bologna, *buh LOHN yuh* (pop. 404,378), a city in northern Italy, lies in a region of pleasant climate and fruitful soil (see **Italy** [political map]). An important industrial center, its manufactured products include farm machinery, motor vehicles, silks, velvets, and Bologna sausage.

Bologna is the capital of Emilia, one of Italy's political regions. Much of the city has narrow and crooked streets, and so retains a medieval appearance. Bologna has a system of *arcades* (roofed walkways) that shelter the shops along the street. It has 130 churches which date from the 1200's to the modern era. Of the 180 towers in the city in the Middle Ages, only two, dating from about 1110, remain. The art treasures of Bologna are world-famous. Raphael's *Saint Cecilia* hangs in the renowned art gallery, Pinacoteca. Bologna is also an ancient center of learning. The University of Bologna, which dates from about 1100, is one of the world's oldest universities. Anthony James Joes

Bologna, *buh LOHN yuh,* **University of,** in Bologna, Italy, is one of the oldest universities in the world. It was formed about 1100, having developed from an association of law teachers and their students. The university was famous throughout Europe during the rest of the Middle Ages for its schools of civil law and liberal arts. The poets Dante and Petrarch studied there. The university is a state-supported coeducational institution with about 59,000 students. It offers courses in agriculture, arts and sciences, engineering, law, mathematics, medicine, pharmacy, teacher training, and veterinary medicine. P. A. McGinley

Bolometer, *boh LAHM uh tuhr,* is a device similar to a highly sensitive thermometer. It measures extremely small amounts of heat produced by certain types of radiant energy, chiefly infrared rays. Bolometers are so sen-

Some kinds of bolts



WORLD BOOK illustrations by Oxford Illustrators Limited

sitive that they can detect infrared rays from the most distant galaxies in the universe.

A bolometer has a thin conducting strip that forms part of an electric circuit. The strip becomes slightly warmer when even a small amount of radiation touches it. This heating of the strip produces a change in the circuit's *conductivity* (ability to carry current). The difference in conductivity shows the strength of the radiation. Some bolometers can operate at temperatures near *absolute zero* (−273.15 °C). The sensitivity of a bolometer increases tremendously at such extremely low temperatures. Samuel P. Langley, an American-born astronomer and physicist, invented the device in 1880. Frank J. Low

Bolsheviks, *BOHL shuh vihks,* were members of a group that became the Communist Party in Russia. The name comes from the Russian word *bolshinstvo,* which means *majority.* In the early 1900's, the Russian Social Democratic Labor Party split into two main groups. Both groups claimed to follow Marxist principles. V. I. Lenin led one group, which believed that a single, centralized party of professional revolutionaries should lead the revolution in Russia. He thought this party could seize power with the help of the workers and peasants. The other group believed in a broader revolutionary party open to anyone who believed in the revolution.

At a party meeting in London in 1903, Lenin's group was clearly in the minority. But it gained a majority vote when seven delegates left the meeting in anger over the question of party membership. Leninists then won control of two powerful party organs—the newspaper and the Central Committee. Lenin began calling his followers *Bolshevik* (majority) and his opponents *Menshevik* (minority). Lenin's group became the *Russian Communist Party* (*Bolshevik*) in March 1918. Diane P. Koenker

See also **Communism; Lenin, V. I.; Mensheviks.**

Bolshoi Ballet, *BOHL shoy,* of Moscow is one of two major ballet companies in Russia. The other is the Kirov in St. Petersburg. The Bolshoi performers are known for their brilliant technical skill and for their vigorous and dramatic dancing.

The Bolshoi company was formed during the 1770's, performing in the Bolshoi Theatre. The company introduced the famous ballet *Swan Lake* in 1877. In 1900, Alexander Gorsky took over the Bolshoi Ballet and developed a group of important dancers. The company became internationally known through its tours during the 1950's. The Bolshoi first performed in the United States in 1959. Selma Landen Odom

See **Moscow** (picture).

Bolt is a type of fastener formed of a metal rod that has an enlarged head at one end and a screw thread at the other. Bolts may be screwed directly into a threaded hole in the part they are to hold, or they may be held in place by nuts. A *nut* is a block of metal with a hole in the center. The hole is threaded to match the threads on the bolt.

Machine bolts have a square or *hexagonal* (six-sided) head. They are made in sizes from $\frac{1}{4}$ inch (6 millimeters) in diameter to 6 inches (15 centimeters) or more, and in a wide range of lengths. *Carriage* bolts, typically used to fasten wood parts, have a rounded head. A small square section beneath the head digs into the wood to prevent the bolt from turning when the nut is screwed on. *Stove* bolts usually have half-round or flat heads that are slotted so they can be used with a screwdriver. *Eye* bolts have a head that forms a loop. *Expansion* bolts have slotted or V-shaped pieces of metal that expand when the bolt is inserted. *Lag* bolts have a pointed end and wide, coarse threads. Paul Bianchina

Boltzmann, Ludwig (1844-1906), was an Austrian theoretical physicist. He made important contributions to the understanding of radiation and to the kinetic theory of gases.

In 1884, Boltzmann deduced an equation, the *Stefan-Boltzmann law.* This law states that the total energy radiated from a body is proportional to the fourth power of the body's absolute temperature. He also developed the *Boltzmann distribution,* a mathematical expression that gives the distribution of energies for a collection of particles at a fixed temperature.

Boltzmann was born in Vienna and graduated from the University of Vienna. He taught at a number of European universities. Boltzmann's published works include *Lectures on Maxwell's Theory of Electricity and Light* (1891-1893) and *Lectures on Gas Theory* (1895-1898).

Arthur I. Miller

Department of Defense

Bombs rank among the most destructive weapons. The crew of an aircraft carrier transports these bombs to a waiting plane.

Bomb is a weapon that explodes. Bombs have been used chiefly in warfare, though terrorists also use them. Bombs kill or injure people and destroy buildings, airplanes, ships, and other targets. Most bombs consist of a metal case filled with explosives or chemicals and a means of exploding or scattering the contents. Some bombs are small enough to be carried by hand. Terrorists often use such bombs. In warfare, small bombs may be thrown as grenades or fired from artillery. However, most bombs are large and dropped from airplanes.

Bombs dropped from planes are considered *gravity weapons* because the earth's attraction pulls the bombs downward. Missiles, which fly under their own power, are sometimes said to carry bombs. However, *warhead* is the correct term for the explosive part of a missile.

Bombs dropped from the air have small tail wings called *fins.* The fins stabilize the bomb and make it fall on a more predictable path. Bombs released from low-flying planes may have small panels called *retardation devices* that open to slow the bomb down. The plane can then fly from the area before the bomb explodes. Parachutes are sometimes used to slow a falling bomb, especially a nuclear weapon.

A device called a *fuse* triggers most bomb explosions. Bombs with *contact fuses* explode when the bomb strikes a target. Bombs with *proximity fuses* explode a short distance above the ground. One type of proximity fuse uses radar to measure the distance from the ground. Another type reacts to increases in air pressure as the bomb nears the ground. A *delay fuse* can be set to explode the bomb minutes or hours after it hits the ground. This type of fuse makes it difficult for the enemy to clear the wreckage from a bombing attack.

There are two main categories of bombs. They are (1) conventional bombs and (2) nuclear bombs.

Conventional bombs

Conventional bombs vary in size and are designed to destroy different kinds of targets. The chief kinds of conventional bombs include (1) general-purpose bombs, (2) guided bombs, (3) armor-piercing bombs, (4) fragmentation bombs, and (5) incendiary bombs.

General-purpose bombs use such explosives as RDX or TNT to shatter targets or kill people. The bombs destroy or kill by a combination of *blast, vacuum pressure, fragmentation,* and *shock.* Blast is the sudden, tremendous wave of air pressure created when the bomb explodes. It blows down walls, breaks windows, and smashes equipment. Vacuum pressure refers to the suction effect that results as the air rushes back into the partial vacuum created by the blast. Fragmentation occurs when the bomb breaks into many small pieces. The pieces fly through the air with bulletlike speed, damaging buildings and injuring or killing people. Shock is the blow transmitted through the ground, water, or structures in which the bomb explodes. It can weaken or destroy underground foundations and shelters.

Most general-purpose bombs weigh from 500 to 2,000 pounds (225 to 900 kilograms). Their length varies from 74 inches (188 centimeters) to 12 $\frac{1}{2}$ feet (3.8 meters). During the late 1960's, the United States built general-purpose bombs weighing 15,000 pounds (6,800 kilograms) for the Vietnam War. The bombs blasted landing areas for helicopters in the jungle.

Guided bombs, also called *smart bombs,* are directed toward targets by electronic equipment. One kind of guided bomb carries a television camera. As the bomb falls, the pilot views the target on a TV screen in the plane. The pilot can adjust the path of the bomb by remote control. Some bombs with TV cameras carry electronic circuits that memorize the picture of the target. The bomb then guides itself. Another type of guided bomb is directed by a beam of light from a device called a *laser.* Before the bomb is released, the laser beam is aimed at the target by the bombing plane, another plane, or a soldier on the ground. The bomb carries a *sensor,* a device sensitive to laser light. The sensor guides the bomb to the laser spot on the target.

Armor-piercing bombs were developed to attack battleships and other heavily armored warships. Such a bomb has a heavy steel nose that can penetrate a ship's armor. The bomb then explodes inside the ship.

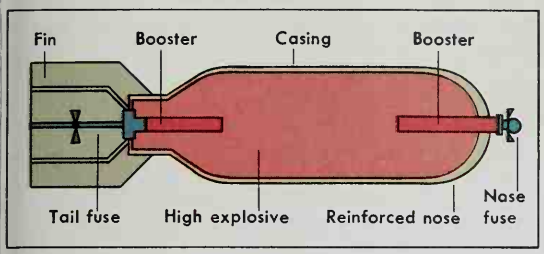
Fragmentation bombs kill and injure enemy troops in open areas and to destroy planes, trucks, and other equipment on the ground. These bombs have many metal fragments or bars that break into jagged pieces when the bomb explodes. The pieces scatter with tremendous speed. A *cluster bomb* consists of hundreds of small bombs packed in a light container. After being released from a plane, the container breaks open. The small bombs, called *bomblets,* then scatter over a wide area. Some bomblets explode when they strike the target. The others rest on the ground and do not explode until a vehicle or a person comes into contact with them.

Incendiary bombs start fires. They are filled with gasoline compounds or *thermite,* a mixture of aluminum and iron oxide. Incendiary bombs weigh from 3 $\frac{1}{2}$ to 1,000 pounds (1.6 to 450 kilograms). The *napalm bomb* is a type of incendiary bomb filled with jellied gasoline. The exploding bomb spreads a sticky gasoline mixture that immediately ignites, setting fires that are extremely difficult to put out. Another type, the *fuel-air bomb,* spreads a cloud of fuel that ignites around the target. The United States used such bombs in the Vietnam War to burn jungle and clear away mines and booby traps.

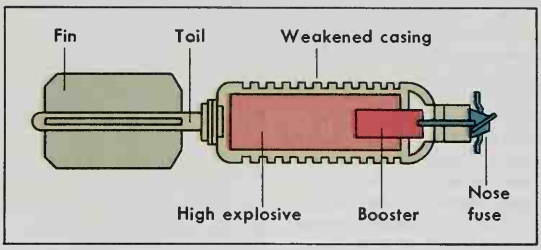
Other conventional bombs include *chemical bombs, depth bombs, leaflet bombs,* and *photoflash*

Main types of bombs

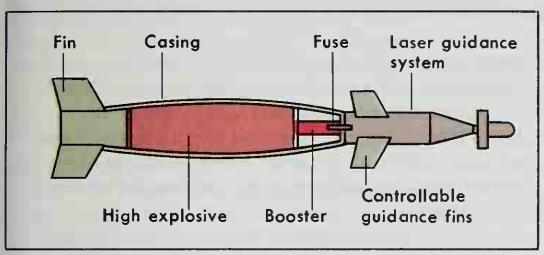
Bombs vary according to the explosive materials they contain and their size and target. Some bombs are designed to sink heavily armored ships and to destroy fortifications. Other bombs are used to kill people or to destroy vehicles. Nuclear bombs are the most destructive of all bombs.



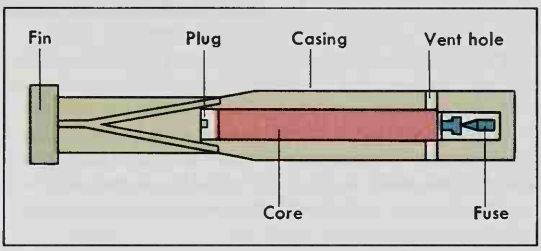
A general-purpose bomb, which is usually dropped from high altitudes, is used to destroy bridges, dams, and factories.



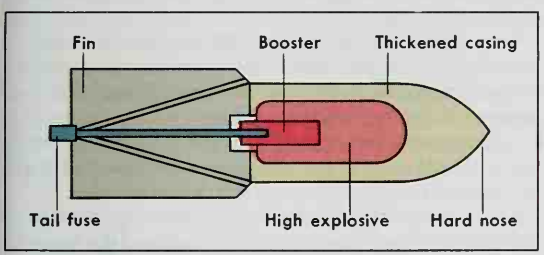
A fragmentation bomb is aimed at troops and vehicles. Metal fragments in the bomb shatter and are scattered widely.



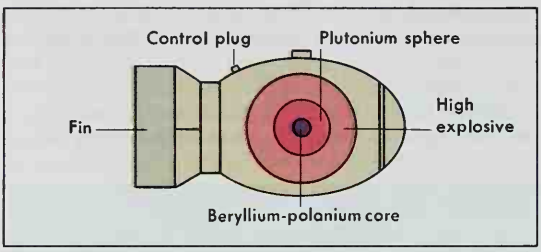
A guided bomb, sometimes called a *smart bomb,* is directed to its target by a laser beam or a television camera.



An incendiary bomb, which contains chemical substances that ignite and start fires, burns buildings, crops, and forests.



An armor-piercing bomb can destroy armored warships. A steel nose enables it to penetrate the ship's armor.



WORLD BOOK diagrams by Steven Liska

An atomic bomb releases huge amounts of energy and causes much greater destruction than a conventional type of bomb.

bombs. Chemical bombs spread smoke or poison gas. Depth bombs explode underwater and are used against submarines. Leaflet bombs carry propaganda printed in the language of the enemy. The bomb blows apart in the air, and the leaflets spread over a wide area. Photoflash bombs provide light for aerial photography at night.

Nuclear bombs

Nuclear bombs produce enormous amounts of blast, vacuum pressure, shock, heat, and radiation. They create far more destruction than conventional bombs. There are two kinds of nuclear bombs: (1) atomic bombs and (2) hydrogen bombs.

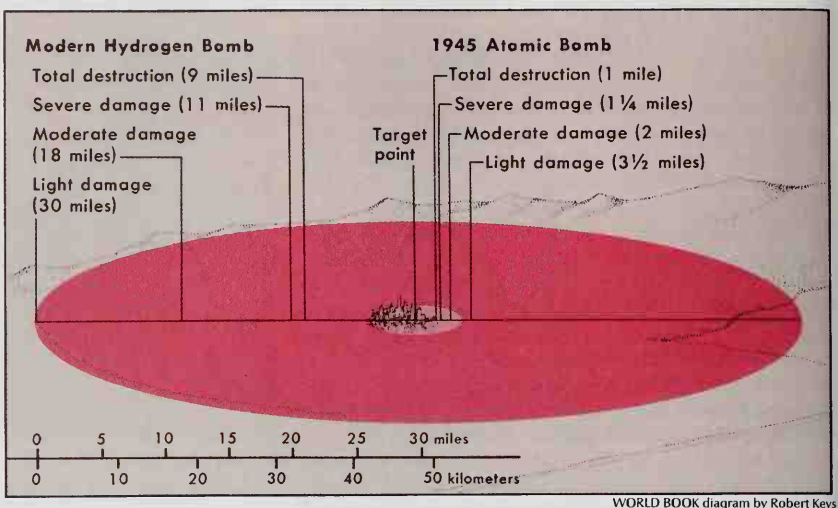
Atomic bombs release huge amounts of energy through the splitting of the *nuclei* (cores) of plutonium or uranium atoms. This process is called *fission.* The United States developed the atomic bomb during World War II (1939-1945) and exploded the first such bomb on July 16, 1945, near Alamogordo, New Mexico. The bomb produced a 19-*kiloton* explosion. One kiloton equals the energy released by 1,000 tons (910 metric tons) of TNT. In August 1945, the United States dropped two atomic bombs on Japan, one on Hiroshima and the other on Nagasaki. The two bombs killed between 120,000 and 140,000 people, largely destroyed both cities, and helped end World War II.

Heat from an atomic bomb can burn exposed skin and ignite combustible materials. Radiation from a 10-kiloton bomb harms people within about 4,000 feet (1,200 meters) of the center of the explosion. They become sick within a few days and die several weeks later. Higher radiation levels kill people within a few days.

Hydrogen bombs, or *thermonuclear bombs,* are far more destructive than atomic bombs. The energy in a

Nuclear blast effect

Some of today's hydrogen bombs have an explosive force thousands of times as powerful as the first nuclear bombs, as shown in the diagram at the right. In 1945, the second atomic bomb used in warfare was dropped on Nagasaki, Japan, by a U.S. bomber. This bomb destroyed everything within about 1 mile (1.6 kilometers) of the target point. Buildings 3 $\frac{1}{2}$ miles (5.6 kilometers) from the center of the explosion suffered only light damage. Some modern hydrogen bombs can cause total destruction within 9 miles (14 kilometers) of the target point and light damage as far away as 30 miles (48 kilometers).



WORLD BOOK diagram by Robert Keys

hydrogen bomb results from the *fusion* (combining) of hydrogen atoms. The United States exploded a 10.4-*megaton* hydrogen bomb in 1952—the first megaton-class hydrogen bomb. One megaton equals the energy produced by 1 million tons (0.9 million metric tons) of TNT. In 1961, the Soviet Union tested the largest hydrogen bomb ever built. It exploded with a reported force of 58 megatons.

A type of hydrogen bomb called a *neutron bomb* or *enhanced radiation bomb* is designed to kill enemy troops without damaging nearby buildings. Neutron bombs produce much radiation but little blast or heat. A neutron bomb of 1 kiloton would produce the same amount of radiation as an atomic bomb of 10 kilotons.

History

Austrian forces used the first aerial bombs in 1849 while trying to put down a revolt in the Italian city of Venice, which Austria controlled. The Austrians attached small bombs with slow-burning fuses to hot-air balloons. Most of the bombs exploded in the air and caused little damage. Italian forces probably dropped the first bombs from airplanes during warfare. They dropped small grenade-type devices in a war against Turkey in 1911.

Heeresgeschichtliches Museum, Vienna

The first aerial bombs were hung from hot-air balloons over Venice, Italy, *shown here,* by the Austrian Army in 1849.

During World War I (1914-1918), American, British, French, and German planes bombed enemy positions. But the raids had little impact on the war. The early bombs were small and were dropped from planes by hand. Bombs used later were larger, but they were hard to aim accurately.

Early in World War II (1939-1945), the Germans made successful and highly destructive bombing raids on Rotterdam, the Netherlands; Warsaw, Poland; and other European cities. Later, the United States and the United Kingdom staged major bombing raids on Germany and German-held areas of Europe. Germany developed the first guided bombs during the war. Some of these bombs had remotely controlled fins that responded to radio signals. The United Kingdom designed the heaviest conventional type of bomb ever used in combat—the "Grand Slam." These bombs weighed about 11 tons (10 metric tons).

The United States dropped over 1 $\frac{1}{2}$ million tons (1.4 million metric tons) of bombs on Germany during World War II. Bombing raids also were important in the war against Japan, even before the dropping of atomic bombs on Hiroshima and Nagasaki. During the Vietnam War, U.S. forces dropped over 6 million tons (5.4 million metric tons) of bombs on Vietnam, Laos, and Cambodia.

Norman Polmar

Related articles in *World Book* include:

Depth charge
Explosive
Fragmentation Grenade
Guided missile
Napalm
Nuclear weapon
Police (picture: Bomb squad technician)

Additional resources

McFarland, Stephen L. *America's Pursuit of Precision Bombing, 1910-1945.* 1995. Reprint. Smithsonian Institution, 1997.

Sherrow, Victoria. *The Making of the Atom Bomb.* Lucent Bks., 2000.

Bombay. See Mumbai.

Bomber is a military airplane that attacks targets on land or at sea. Bombers carry bombs, missiles, rockets, machine guns, and cannons. The air force of almost every nation includes bombers, and some naval and marine services also have them.

Some bombers carry bombs and missiles under their wings on vertical structures called *pylons.* In other bombers, these weapons are carried in a *bomb bay,* a compartment in the body of the aircraft. The bombs and missiles are aimed by the plane's *bombing system.* This system uses radar, optical devices, or a laser to locate the target, and a computer that tells when the weapons should be released. Such systems enable a bomber to attack day or night and in almost any weather.

Most bombers are powered by one or more jet engines, and some of these aircraft can fly as fast as 1,650 miles (2,655 kilometers) per hour. A bomber's range depends primarily on the weight of its *payload,* the combined weight of the plane's fuel and weapons. The plane's range can be increased by carrying more fuel and fewer weapons. Flying at low speeds and at high altitudes, where a plane encounters less air resistance, saves fuel and thus increases the range. The range of bombers can also be extended if they are refueled in the air by tanker planes.

Kinds of bombers. Today, there are two main kinds of bombers, *fighter-bombers* and *strategic bombers.* Each performs a particular type of mission.

Most fighter-bombers are small, short-range planes with a crew of one or two people. These planes, which are also called *attack planes,* carry out *tactical air attacks.* Such assignments involve attacks against ships, *interdiction attacks,* and *close air support.* Interdiction attacks are made behind enemy lines in order to prevent reinforcements from reaching a battle area. In close-air-support missions, bombers attack enemy ground troops and other targets in the battle zone. An observer located on the ground or in a plane directs most close-air-support operations.

McDonnell Douglas

A fighter-bomber, like this U.S. Marine Corps AV-8B Harrier II, can carry bombs and guided missiles under its wings.

Most strategic bombers are large, long-range airplanes with a crew of four to six people. They carry out *strategic air attacks,* which involve striking far behind enemy lines. Targets include factories, military bases, ports, and entire cities. Such attacks are designed to destroy the enemy's ability to fight.

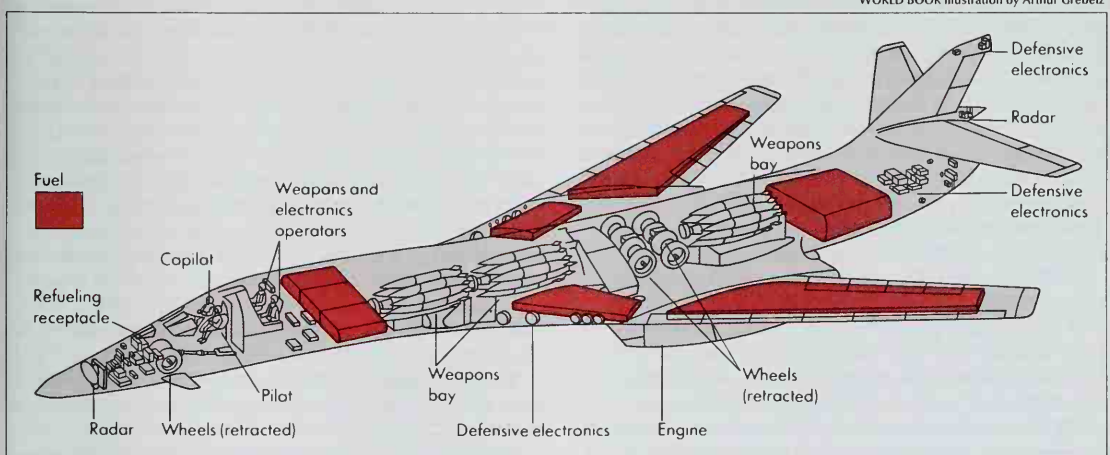
History. During the early part of World War I (1914-1918), pilots dropped small bombs by hand from the open cockpits of their planes. Germany later developed the Gotha, one of the first bombers. It carried more than 500 pounds (230 kilograms) of bombs.

The development of bombers increased rapidly during World War II (1939-1945). Two of the most famous bombers were United States planes, the B-17 Flying Fortress and the B-29 Superfortress. Both bombers could carry several tons of bombs and had machine guns for protection against enemy planes. Other important bombers of the war included Britain's DH-98 Mosquito and Germany's Junkers Ju 87 Stuka. Dive bombers and torpedo bombers were used to attack ships with considerable success during World War II. Dive bombers flew almost straight down before releasing their bombs. The torpedo bomber released a self-propelled torpedo.

Cross section of a strategic bomber

A strategic bomber like this B-1B can strike distant targets with bombs or missiles. This war plane can fly great distances because it carries a large quantity of fuel and also can be refueled in flight. Radar and other electronic devices protect it and guide it to its targets.

WORLD BOOK illustration by Arthur Grebetz



Jet bombers were first developed by Germany during World War II. These planes carried fewer crew members and fewer defensive guns than nonjet aircraft. As a result, they had more space for fuel and bombs.

In 1988, the United States Air Force unveiled the B-2 "stealth" bomber. The plane's flat, angular surfaces and its special surface materials make it difficult to detect by radar. Norman Polmar

See also **Aircraft, Military; Air force; Air Force, U.S.; Bomb.**

Bomoh is a person who provides cures for illness in Malaysian and Indonesian villages. In Indonesia, the person is known as a *dukun.* If there is an unexplained illness and *sorcery* (witchcraft) is suspected, the bomoh will try to find the magic cause. A bomoh or dukun may be a man or a woman. Bomohs use herbs and chants to cure illness. They never perform surgical operations, but do other work that in many countries is done by doctors. Every village has at least one bomoh. A bomoh or dukun also may be consulted to explain dreams, provide magic charms, and even try to catch thieves or help lovers win the hearts of their beloved.

Bonaparte, Napoleon. See **Napoleon I.**

Bonaventure, *BAHN uh VEHN chehr,* **Saint** (1221-1274), was a medieval theologian and religious leader. In 1257, he became minister general of the Franciscan religious order. Bonaventure restored unity among disagreeing friars in the order. He supported the Franciscan ideal of poverty but also defended the possession of books and buildings for the pursuit of learning. He believed friars should study and teach in universities. He wrote many influential religious works and a biography of Saint Francis of Assisi, the Franciscans' founder.

Bonaventure was born in Bagnorea, near Viterbo, Italy. His family name was Fidanza. Bonaventure studied and taught at the University of Paris during the mid-1200's. Bonaventure was named cardinal bishop of Albano in 1273. He was *canonized* (declared a saint) in 1482. Bonaventure's feast day is July 15. Marilyn J. Harran

See also **Scholasticism.**

Bond is a certificate issued by a business company or government promising to pay back money it has borrowed. The issuer of the bond promises to return to the bondholder the *principal* (amount borrowed) when the bond *matures* (comes due) at some future date. Most bonds pay interest at regular intervals. Because the person who buys a bond is a creditor and not a stockholder, bonds enable businesses and other issuers to raise funds without enlarging the pool of owners.

How bonds are issued. Bonds are usually issued in groups. Each bond represents a fraction of the amount being borrowed. A person could buy a bond of $1,000 denomination that is part of a $100,000 issue. This type of issue enables people of moderate means to invest, and enables businesses to obtain substantial funding. Many bonds are traded on stock exchanges.

Kinds of bonds. There are several kinds of bonds. *Mortgage bonds* give the investor a claim on some or all of a company's property. Such a claim, called a *lien,* is given as security in case the loan is not repaid when due. *Debentures* are bonds that are not protected by a lien. *Collateral trust bonds* are secured by property called *collateral* (often stocks or bonds) deposited with a trustee. *Income bonds* promise to repay principal but to pay interest only when there are earnings. *Callable bonds* may be redeemed by the issuing corporation under stated conditions before maturity. *Serial bonds* mature in relatively small amounts at stated intervals. *Municipal bonds* are issued by state or local governments. *Inflation-indexed bonds* protect bondholders from being repaid in dollars whose value has been reduced by *inflation* (rising prices). The amounts investors receive are adjusted to correspond to current market prices.

Bond ratings. Bonds are assigned ratings by independent organizations, such as Moody's Investors Service and Standard & Poor's Corporation, based on their degree of risk. Risk is determined by how likely it seems that the issuer might *default* (fail to meet its obligations). The riskier a bond, the lower its rating. Because investment experts perceive large, established companies as low-risk, bonds issued by such companies usually have *investment-grade ratings.* These ratings mean that the companies pay lower interest rates to investors. Bonds with noninvestment grade ratings must offer a higher rate of interest to make up for their higher risk. Such bonds—also called *high-yield bonds* or *junk bonds*—have gained popularity among investors because their high interest rates often more than make up for the risk of default. Many companies issue such bonds to raise money for investing in new technologies.

Glenn Yago and Lalita Ramesh

Related articles in *World Book* include:

Blue-sky laws
Interest
Investment (Bonds)
Investment banking
Negotiable instrument
Savings bond
Stock exchange

Bond, in chemistry, is the attraction that holds atoms together in groups of two or more. Bonds hold together every substance in the universe that is made of atoms. Bonds arise from the activity of *electrons,* negatively charged particles that whirl about the positively charged nucleus of an atom. A bond forms when an electron that belongs to one atom forms a pair with an electron that belongs to another atom. There are two main types of bonds: (1) covalent and (2) ionic. A group of atoms held together by covalent bonding is called a *molecule.* Ionic bonds hold together *ionic compounds.*

A covalent bond forms when each of two atoms contributes one electron to a pair, which the atoms then share. The bond is the electrical attraction of the positively charged nuclei of the two atoms for the negatively charged electron pair. A hydrogen molecule (H_2) consists of two hydrogen atoms linked by a covalent bond. The atoms share the electron pair equally. A *polar covalent bond* forms when one atom has a stronger attraction for the electron pair. This atom gains a slight negative charge. The other atom becomes slightly positive.

An ionic bond results when one atom loses an electron to form a *positive ion,* and another atom accepts the electron to form a *negative ion.* The attraction between the two atoms holds them together. Most ionic compounds, such as table salt—sodium chloride (NaCl)—are solids in which the positive and negative ions pack together to form a crystal.

Other linkages. A linkage called an *intermolecular force* results when the negative charge associated with a polar bond in one molecule interacts with the positive charge of another molecule. A *hydrogen bond* is a weak

intermolecular force between a hydrogen atom in one molecule and an electron pair associated with an oxygen (O), nitrogen (N), or fluorine (F) atom in another molecule. Hydrogen bonds are largely responsible for the attraction between water (H_2O) molecules. This attraction gives water its ability to form drops. Melvyn C. Usselman

See also **Ion; Materials** (The role of bonds); **Molecule.**

Bond, Carrie Jacobs (1862-1946), was an American composer best known for her sentimental popular songs. The most successful of her many songs were "I Love You Truly," first published in her collection *Seven Songs* (1901), and "A Perfect Day" (1910). She wrote the words and music for both songs. Bond also published several collections of stories, essays, and poetry; and wrote many articles for newspapers. Bond wrote an autobiography, *Roads to Melody* (1927). She was born in Janesville, Wisconsin.

Bond, Julian (1940-), is an African American civil rights leader. He was elected chairman of the board of directors of the National Association for the Advancement of Colored People (NAACP) in 1998. Before becoming board chairman, Bond had fought for civil rights in a variety of roles, including those of student protester, Georgia state legislator, and university professor.

Horace Julian Bond was born in Nashville. In 1960, he helped found the Student Nonviolent Coordinating Committee (SNCC). He served as its communications director from 1961 to 1966. From 1960 to 1963, he led student protests against segregation in public facilities.

From 1965 to 1975, Bond served as a Democratic member of the Georgia House of Representatives. After his election to the House, the members at first refused to seat him. They said they objected to his opposition to U.S. involvement in the Vietnam War. In 1966, the Supreme Court of the United States ruled that the House had denied Bond freedom of speech and must seat him.

At the 1968 Democratic National Convention, Bond led a group that challenged the seating of the Georgia delegation appointed by Governor Lester G. Maddox. The dispute was settled by giving each of the two delegations half of Georgia's votes.

Bond graduated from Morehouse College in Atlanta, Georgia, in 1971. That same year, he helped found the Southern Poverty Law Center. He was the organization's president from 1971 to 1979. The center works through the courts to protect the legal rights of poor people of all races.

From 1975 to 1987, Bond served in the Georgia Senate. He resigned from the Senate to run for election to the U.S. House of Representatives but was defeated by civil rights leader John Lewis. In the 1980's and 1990's, Bond taught at several universities, including American, Drexel, and Harvard universities and the University of Virginia. Alton Hornsby, Jr.

Bondar, Roberta (1945-), a doctor of medicine, became the first Canadian woman to travel in space. In January 1992, she and six other astronauts made an eight-day flight aboard the space shuttle Discovery. During the mission, Bondar studied how space flight affects human beings and how gravity affects and helps shape materials and living things. She experimented with crystals, plants, and insects. She also developed tools and techniques for conducting research in the apparent weightlessness of orbiting spacecraft.

NASA

Roberta Bondar

Roberta Lynn Bondar was born in Sault Sainte Marie, Ontario. She earned a Ph.D. in neurobiology from the University of Toronto in 1974 and an M.D. degree from McMaster University in Hamilton in 1977. She became an astronaut in 1983. Bondar's medical specialty is *neurology,* the study of the nervous system and its diseases. Lillian D. Kozloski

Bonded warehouse is a facility used to store goods on which the goods' owner must pay the government a tax or duty. Warehouse operators *bond* themselves through a bonding company to guarantee the government that this payment will be made before the goods are released from storage. The use of a bonded warehouse permits an owner of goods to store them without paying the entire tax or duty at once. The owner pays part of the tax or duty only as the goods are withdrawn from storage. A bonded warehouse is privately owned and bonded in part or in whole. It operates under government supervision. Goods are said to be *in bond* while they are in storage. Joanna H. Frodin

Bonderizing is a process of coating a metal with a protective material. Automakers and other manufacturers use this process mainly on iron, steel, aluminum, or zinc. Bonderizing begins by spraying the metal with a hot solution of a *phosphate* (a chemical containing phosphorus) or by dipping the metal in this solution. A chemical reaction then changes the surface materials into an insoluble phosphate such as iron phosphate. Bonderizing prevents rust and *corrosion* (destruction by chemical action) and helps paint or lacquer stick to metals. Marvis E. Hartman

Bondfield, Margaret Grace (1873-1953), was a British Labour politician who became the first woman member of the Cabinet, as minister of labor from 1929 to 1931. Bondfield was born in Chard, England. After working as a shop assistant, she became secretary of the National Federation of Women Workers. In 1923, she became chairman of the Trades Union Congress.

Bonding is a method of protecting the government, individuals or companies against loss through the dishonesty of others or the failure of others to fulfill certain contracts or obligations. Such bonds are issued by surety companies and insurance companies. Types of bonds include *fidelity bonds, surety bonds, bail bonds,* and *appeal bonds.*

Fidelity bonds are obtained by many employers for employees who handle money or property. If the employee steals money or commits a dishonest act which causes financial loss to the employer, the bonding company must pay the loss as provided by the terms of the bond. The company which issues the bond usually investigates the employee to make sure that he or she has a record of honesty. Fidelity bonds make up a large class of the bonds written in the United States. *Blanket fidelity bonds* are sold to banks and other financial insti-

tutions to protect them against such losses as theft, forgery, and robbery. Types of blanket bonds are also available for other public and commercial enterprises.

Surety bonds guarantee performance or obligations authorized by law. There are many types of surety bonds. For example, *performance bonds* guarantee that contractors will do jobs properly and on time. *Public official bonds* may be required of people holding government positions. They provide surety for people responsible for public money, and guarantee, in effect, that the official will carry out the prescribed duties. *Fiduciary bonds* guarantee the performance of people appointed by a court to be responsible for another's property. Such people include executors of wills and guardians.

A bail bond is usually required of an arrested person who is permitted to go free until his or her trial is heard in court. If the person fails to appear for trial, the bond is forfeited to the court. An appeal bond is required of the defendant in a court case to insure that the *judgment* (award) of the lower court will be paid if affirmed by the higher court in review. Dan R. Anderson

See also **Arrest; Bail; Insurance** (Other kinds of property and liability insurance).

Bonds, Barry (1964-), holds baseball's major league record for home runs in a season with 73. He set the record in 2001, breaking the record of 70 set by Mark McGwire in 1998. In 2002, Bonds became the fourth player to hit 600 or more career home runs.

Bonds is one of baseball's best all-around players. He is a power hitter who also hits for a high average. In 2002, he led the National League in batting with a .370 average. Bonds is the only player in major league history to record more than 400 home runs and 400 stolen bases during a career. In 2002, he set a major league record for walks in a season, with 198. He bats and throws left-handed and is an outstanding defensive outfielder. He has won the Gold Glove award several times for his defensive skill.

Bonds was selected the National League's Most Valuable Player (MVP) in 1990, 1992, 1993, and 2001. He became the first major league player to be named MVP four times.

Bonds was born in Riverside, California, on July 24, 1964. His father, Bobby Bonds, was also a star outfielder in the major leagues. The Pittsburgh Pirates chose Barry in the 1985 free agent draft. He played in the minor leagues in 1985 and then joined Pittsburgh in 1986. Bonds signed with the San Francisco Giants after the 1992 season. Dave Nightingale

Bone is a hard substance that forms the framework of the bodies of animals with backbones, including human beings. The separate parts of this framework are called *bones.* A smooth material called *cartilage* makes up the ends of long bones. The junctions between neighboring cartilage surfaces, which are surrounded by *ligaments* (fibrous tissues), are referred to as *joints.*

Each bone and each joint have a name. For example, the bone of the upper arm is called the *humerus,* the bones of the forearm are known as the *radius* and the *ulna,* and the joint formed by these bones is the elbow. Some bones are closely attached to one another in groups and form a special structure, such as the skull.

Bones give shape to the body. They support the body and protect its vital organs. Bone also stores such minerals as calcium, phosphate, and sodium and releases them into the body as needed. All the bones, joints, and special groups of bones make up the skeleton. Muscles and tendons move the skeleton and all its parts. Bones, ligaments, muscles, and tendons together are called the *locomotor* or *musculoskeletal* system.

Bone is one of the most active tissues of the body. The body constantly breaks down bone and rebuilds it in a process called *bone turnover.* About 3 percent of bone in children is broken down and rebuilt each year. Turnover proceeds at a lower rate in adults. It makes slightly less bone than it breaks down. Thus, turnover in adults leads to gradual, progressive bone loss.

Structure of the bones. Most bones have solid, hard tissue called *compact* or *cortical bone* on the outside and spongy, honeycombed *cancellous* or *trabecular bone* on the inside. Cancellous bone supports the ends of bones and transfers weight from the ends to the central part of the bone. Compact and cancellous bone occur in different proportions in different parts of the skeleton. There is much cancellous bone at the ends of long bones, in the pelvis, and in the upper portion of the *femur* (thigh bone). Other bones with much cancellous bone include the *vertebral bodies* (weight-bearing portions of the spine). In the front of the skull, air-filled cavities called *sinuses* replace the cancellous bone.

Bones are covered on the outside by a fibrous membrane, the *periosteum,* and lined inside by the *endosteum.* The center of a bone, called the *medullary cavity,* is filled with either red or yellow *bone marrow.* Yellow bone marrow consists mostly of fat. Red bone marrow is a network of blood vessels, connective tissue, and blood-forming cells. Red bone marrow makes red blood cells. All bones have blood vessels and nerves.

Long bones have three parts: (1) the *diaphysis,* (2) the *metaphysis,* and (3) the *epiphysis.* The diaphysis, also called the *shaft,* is the long central part of the bone. The metaphysis is the flared area near the end of the bone. The epiphysis is the rounded end.

Development of bones. Bones begin to develop long before birth. A process called *intramembranous bone formation* creates the top of the skull. In this process, bone directly replaces soft connective tissue. Long bones develop by a process called *endochondral bone formation,* in which cartilage replaces soft connective tissue and bone, in turn, takes the place of cartilage.

Long bones grow by means of a structure called the *epiphyseal growth plate.* The growth plate is a thin disk of cartilage between the metaphysis and epiphysis. A new layer of bone successively replaces each layer of cartilage in a process called *intracartilaginous bone formation.* In this way, the growth plate and epiphysis grow away from the central part of the bone and the shaft gradually grows longer. The growth plate functions throughout childhood and adolescence and stops functioning when a person reaches adult height.

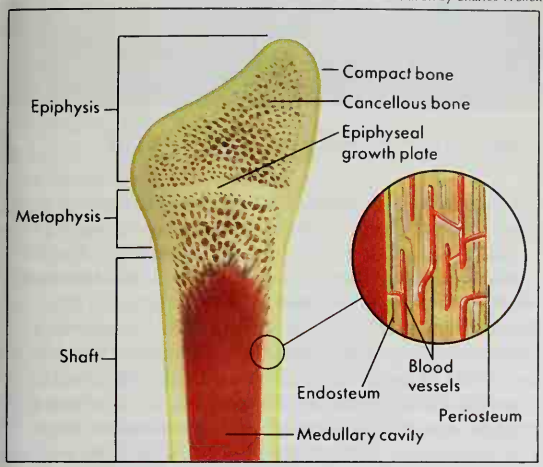
Composition of bone. About two-thirds of the weight of bone tissue consists of minerals, mostly calcium, phosphate, and carbonate. The rest is organic material, largely the fibrous protein *collagen.* When boiled in water, collagen yields gelatin. The nonmineral component of bone, containing collagen and other protein substances, is called the *bone matrix.*

Bone tissue contains three kinds of specialized cells:

Parts of a bone

There are two forms of bone, hard *compact bone* and spongy *cancellous bone*. The bone's center, called the *medullary cavity*, is filled with marrow. The blood vessels and nerves in bone appear in the close-up.

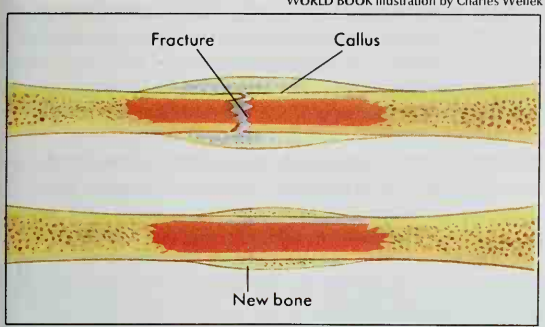
WORLD BOOK illustration by Charles Wellek



Healing of a fracture

A fracture heals by forming a mass of new tissue called a *callus*. The healing process may take from four weeks to a year.

WORLD BOOK illustration by Charles Wellek



(1) *osteoblasts,* (2) *osteocytes,* and (3) *osteoclasts.* Osteoblasts form bone matrix by laying down collagen fibers and other proteins and depositing hard mineral material. Osteocytes are osteoblasts that have become trapped in the bone matrix they manufactured and live embedded there for years. Osteocytes help to control the mineral balance of the body and also respond to the stresses created by physical activity. Osteoclasts erode the matrix during normal bone turnover, during growth, and during the healing of fractures.

Broken bones. When a bone breaks, a doctor should set it as soon as possible and put it in a plaster cast if necessary. The cast holds the bone securely in place. When a bone breaks into several pieces, doctors may wire or pin the pieces together for proper healing. In most cases, the body forms a *fracture callus,* a mass of new cartilage and bone, to hold the broken ends together. New bone gradually replaces the callus to finally heal the fracture. This process takes from four weeks to a year, depending on the size of the bone, the location of the fracture, and the patient's age and health. In some cases, the break does not heal by itself. Doctors treat such *nonunion fractures* with bone grafts or with electrical current to stimulate bone growth.

Bone disorders. The most common bone disorder is *senile osteoporosis,* which means *porous bones of old age.* Osteoporosis results when the loss of bone tissue that comes with aging weakens the bones and makes them prone to fracture. Exercise helps strengthen bones.

An insufficient supply of calcium, phosphate, or vitamin D in the body causes a person's bones to soften. This condition is called *rickets* in children and *osteomalacia* in adults. *Osteitis fibrosa* is the destruction of bone by osteoclasts. It is caused by overactivity of the parathyroid glands, which release a hormone that stimulates osteoclasts to erode bone. Robert Marcus

Related articles in *World Book* include:

Bone bank	Haversian canals	Osteoporosis
Bone marrow transplant	Human body (The skeletal system)	Osteosclerosis
Cartilage	Joint	Rickets
Collagen	Orthopedics	Sinus
Dislocation	Osteology	Skeleton
Fracture	Osteomyelitis	Skull
		Tendon

Additional resources

Simon, Seymour. *Bones: Our Skeletal System.* Morrow, 1998. Younger readers.
White, Tim D. *Human Osteology.* 2nd ed. Academic Pr., 2000.

Bone bank is a medical supply of bone that can be used in surgical operations. Doctors use the bone to repair fractures, to replace diseased bone, or to fill in missing bone segments in children and adults.

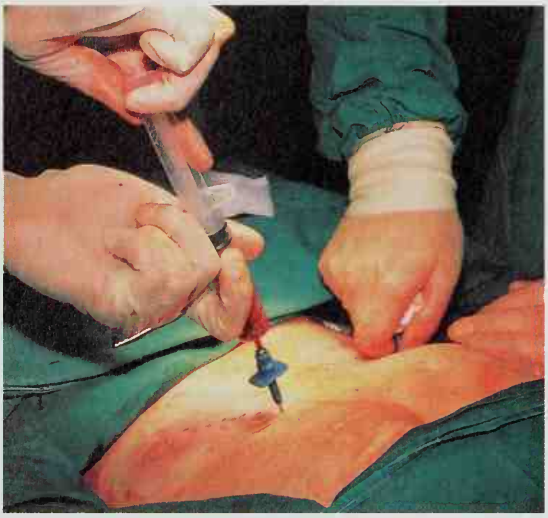
The bone stored in a bone bank comes from people who have had healthy bone removed as part of an amputation or other surgery. The bones may be cut into small chips or thin strips for easy storage. Careful surgical techniques are used to ensure that the bone is sterile. It is preserved by freezing or by using special chemicals.

Perhaps the best-known bone bank in the United States is the Tissue Bank at the National Naval Medical Center, Bethesda, Maryland. Scientists also preserve skin, muscle, brain membranes, and blood vessels there. James A. Hill

Bone marrow transplant is a medical procedure in which diseased or defective bone marrow is replaced with healthy marrow. Bone marrow is the tissue within bones that produces blood cells. Certain diseases, such as leukemia or sickle-cell anemia, impair bone marrow function. Some cancer patients need a bone marrow transplant after receiving high doses of drugs or radiation to treat their cancer because such treatments destroy bone marrow.

Prior to transplant, physicians destroy the recipient's bone marrow with high doses of drugs, radiation, or both. Doctors may also administer drugs to suppress the patient's disease-fighting immune system so it cannot *reject* (attack) the transplanted cells. The treatments leave patients vulnerable to infection, and they must be isolated until the new bone marrow functions normally.

The cells of the bone marrow donor and the recipient must have similar *HLA antigens* (substances that cause an immune reaction if not matched). Family members usually make the best donors. Patients can also receive a



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Preparing for a bone marrow transplant, doctors collect bone marrow from a donor. A surgeon inserts a hollow needle into the donor's hipbone to *aspirate* (suck out) the marrow.

transplant from an unrelated person whose HLA genes match their own. Cancer patients scheduled to receive treatments that will destroy their bone marrow can donate their own marrow for an eventual transplant. The bone marrow cells can be frozen and stored for years.

Some immune system cells of the donor are transplanted along with the bone marrow. These cells can attack the cells of the recipient in a serious reaction called *graft-versus-host disease.* The risk of this reaction increases when the donor and recipient are not a good HLA match. In leukemia patients, the same immune reaction attacks any leukemia cells that remain after treatment with drugs or radiation. This otherwise harmful reaction helps ensure the leukemia will not return.

Doctors transplant bone marrow by injecting it into the recipient's bloodstream. Bone marrow contains cells called *stem cells* that can develop into many types of cells. The transplanted stem cells migrate into the patient's bone marrow spaces, where they begin producing healthy blood cells.

Blood from the discarded umbilical cord and placenta of newborn babies, called *cord blood,* is also a source of stem cells. A delivery-room team can easily collect this blood minutes after birth without disturbing the mother or child. Stem cells from cord blood are less likely to cause graft-versus-host disease when transplanted, even without a good HLA match. Physicians can use these cells for patients in need of a bone marrow transplant when no suitable donor can be found.

John E. Wagner, Jr.

See also **Blood; Stem cell; Transplant.**

Bonefish is a type of fish that lives in shallow waters of most tropical and subtropical seas. The *common bonefish* ranges from California to Peru in the Pacific Ocean and from New Brunswick to Brazil in the Atlantic. The common bonefish is highly prized as a sports fish. However, it is not valued as a food fish.

Some bonefish weigh as much as 22 pounds (10 kilograms) and are more than 3 feet (90 centimeters) long, but most are much smaller. Bonefish eat clams and other mollusks, as well as crustaceans, such as crabs.

Fred McConnaughey, Photo Researchers

A bonefish has dark skin and a deeply forked tail.

Tomio Iwamoto

Scientific classification. Bonefish are in the bonefish family, Albulidae. The common bonefish is *Albula vulpes.*

Boneset, *BOHN seht,* is a flowering plant that grows wild in meadows and lowlands. It is found in the eastern two-thirds of the United States and Canada. Boneset is also called *thoroughwort* (pronounced *THUR oh wurt*). Its stem is from 2 to 5 feet (60 to 150 centimeters) high. The stem passes through the middle of two hairy leaves that are joined around it. The flowers, which vary from grayish-white to bluish-purple, bloom in the fall.

The dried leaves and the stalks of the plant are brewed to make a medicinal tea. This tea reduces fever and is used as a tonic and a laxative. It was named *boneset* because it relieved dengue, or breakbone fever. It is also called *thoroughwort* because the leaves are joined around the stem. Margaret R. Bolick

Scientific classification. The boneset belongs to the composite family, Asteraceae or Compositae. Its scientific name is *Eupatorium perfoliatum.*

Bonfils, *BAHN fihlz,* **Frederick Gilmer** (1860-1933), was an American newspaper editor who became famous for sensational presentation of news. In 1895, he and Harry H. Tammen bought *The Denver Post* for $12,500. They increased the paper's circulation by using such devices as red banner headlines. Bonfils and Tammen also exposed the Teapot Dome scandal of the 1920's (see **Teapot Dome**). Bonfils was born in Troy, Missouri. Michael McGiffert

Bongo drums are high-pitched percussion instruments. Bongo drums, often called *bongos,* are primarily used as rhythm instruments in Latin American music, but they are also played in rock music and jazz.

Bongos are played in pairs attached at the center. One drum has a smaller diameter than the other to produce a higher-pitched sound. A thin covering of plastic or animal skin called the *head* is stretched tightly across the top opening of a cylindrical wooden shell. Musicians strike the head with the fingers or with the en-

© Peter Gonzalez

Bongo drums

tire hand. They may also use sticks made of wood or felt.

Most musicians play bongos while sitting down. The drums are held between the player's knees, with the larger drum on the right. In orchestras and concert bands, however, bongos are played while standing up, with the drums mounted on a stand. John H. Beck

Bonheur, *baw NUR,* **Rosa** (1822-1899), a French artist, was the most successful female painter of her time. She became known for paintings of domesticated animals and of agricultural scenes. Many of her paintings were monumental in scale and offered an idealized vision of life in the French countryside. Like other realist painters of her generation, Bonheur depicted rural scenes with specific detail. She wanted the locations of her pictures to be recognizable as particular regions of France.

Marie Rosalie Bonheur was born on March 16, 1822, in Bordeaux. She believed strongly in the equality of women with men. Early in her career, she committed herself to personal independence and an unconventional lifestyle. She often adopted men's customs and clothing, which made her notorious in French society. In 1894, she became the first female officer in the French Legion of Honor. Her painting *The Horse Fair* (1853) was among the most popular paintings of the 1800's. Richard Shiff

See also **Buffalo Bill** (picture).

Bonhoeffer, *BAHN hohf ur,* **Dietrich,** *DEE trihk* (1906-1945), was a German theologian whose strong opposition to Nazism cost him his life. His faith and heroism, even more than his ideas, made him one of the most influential Christian philosophers born since 1900.

Bonhoeffer was born in Breslau on Feb. 4, 1906. He studied religion in Berlin and New York City. After returning home as a Lutheran pastor in 1931, he wrote some books and began to earn a reputation as a scholar. In 1933, Adolf Hitler became dictator of Germany. That year, Bonhoeffer left to serve as a pastor in London. He returned to Germany in 1935 to direct a seminary of the Confessing Church. The church opposed Nazi racism and helped Jews escape from Germany. After the Nazis closed his seminary, Bonhoeffer became a German military intelligence agent. He secretly used this post to spread information about the resistance movement against Hitler. In 1943, the Nazis found Bonhoeffer guilty of conspiracy. They hanged him in 1945.

Letters and diaries that Bonhoeffer wrote in prison were published in *Prisoner for God* (1951). In this book, he said churches were no longer vital because they had not condemned Nazism. He advocated a "religionless Christianity" that could preserve Christian values without the ideas of a supernatural God. Donald M. McKale

Bonhomme Richard. See **Jones, John Paul.**

Boniface VIII (1235?-1303) was elected pope in 1294. During his reign, he was often in conflict with King Philip IV of France. In 1301, Boniface and Philip had a dispute over the right of the French king to condemn a bishop. As part of the propaganda war that followed, Boniface issued a famous *bull* (papal decree) called *Unam sanctam.* It was the strongest affirmation of papal authority over *secular* (nonreligious) rulers and all Christians ever issued by a pope. In the bull, Boniface claimed that all human beings must subject themselves to the pope if they wished to be saved. Philip accused Boniface of many crimes and sent an adviser and soldiers to bring the pope to trial. Boniface was seized in Anagni, near Rome. As a result of this experience, his health rapidly declined, and he soon died.

Boniface was probably born in Anagni. His given and family name was Benedetto Gaetani. He studied law and had a long career in papal administration. Although learned, he was impulsive, cruel, and often rash in his judgments. Kenneth Pennington

See also **Roman Catholic Church** (Boniface VIII).

Boniface, Saint (675-754), was an English-born Christian missionary noted for his work in Germany. Boniface became known as the *Apostle of Germany.* As a bishop and later as archbishop of Mainz, he helped set up an organized church in Germany. He converted many Germans and founded some of Germany's first monasteries.

The Metropolitan Museum of Art, New York (WORLD BOOK photo by Robert Crandall)

Rosa Bonheur's *The Horse Fair* is the artist's best-known work. It was first exhibited in 1853, and is typical of her large paintings portraying animals in vivid movement.

Boniface was born in the county of Devon. His original name was Winfrid. He became a priest about 705 and received the name of Boniface from Pope Gregory II in 718. Boniface worked for several years as a missionary in what is now the province of Friesland in the northern part of the Netherlands. However, he spent most of his life doing missionary work in central and western Germany. As a *legate* (special representative) of the pope, in 751 he anointed Pepin the Short, who was the first king of the Carolingian dynasty. About 754, Boniface returned to Friesland. He was killed by pagans there during a confirmation service for converts. His feast day is June 5, the day of his death. Marilyn J. Harran

Bonifácio, José. See Andrada e Silva, José.

Bonin Islands, *BOH nihn,* include 97 volcanic islands that are about 600 miles (970 kilometers) south of Tokyo. The islands are owned by Japan. They are also called the Ogasawara Islands. The three main groups of the Bonin Islands include the *Chichishima* (Beechey) group, the *Hahajima* (Bailey) group, and the *Mukoshima* (Parry) group (see **Pacific Islands** [map]).

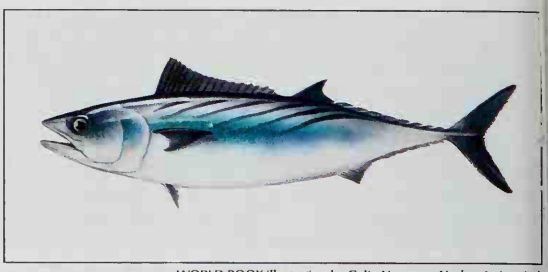
The islands have a total area of about 41 square miles (106 square kilometers). Chichi Jima, the largest and most important island, covers 15 square miles (39 square kilometers). The Bonin Islands are rocky and covered with scrubby trees and tall grass. The warm Kuroshio, or Japan Current, flowing between the islands and Japan makes the climate mild and warm. About 2,800 people live on the Bonin Islands. They raise fruits, sugar cane, cacao, vegetables, and cattle, and make coral ornaments.

The Bonin Islands were colonized in 1830 by adventurers from Honolulu. Japan claimed the islands in 1875, and named them *Ogasawara-gunto.* About 6,000 Japanese lived there before World War II (1939-1945). During the war, Japan used the islands as military bases. United States forces attacked the Japanese there. Later, the islands were placed under U.S. control. All Japanese were removed, but the United States allowed some of the original colonists to return. Control of the islands returned to Japan in 1968. Kenneth B. Pyle

Bonington, *BAHN ihng tuhn,* **Richard Parkes** (1801-1828), an English landscape painter, might have won fame during his lifetime had he not died so young. He worked in oil and water color. Bonington's landscapes are luminous and rich in color, and brilliantly executed.

Bonington was born in Arnold, a suburb of Nottingham, but he spent his adult life in France. He studied under Baron Antoine Jean Gros, a painter. Bonington also studied at the École des Beaux-Arts in Paris. He was a close friend of Théodore Géricault and Eugène Delacroix. He helped acquaint the French romantic artists with the quality of English landscape painting. His work is a connecting link between the English romantic landscapes of Thomas Girtin and John Constable and those of the later French Fontainebleau or Barbizon movements. Douglas K. S. Hyland

Bonito, *buh NEE toh,* is a large fish that lives in the open sea. Four species of bonitos live in the Atlantic, Pacific, and Indian oceans. The *Atlantic bonito* ranges from Argentina and South Africa north to Nova Scotia and Scandinavia. The *Australian bonito* is found along the east coast of Australia. The *Pacific bonito* ranges north to Puget Sound and south to Chile. The *striped bonito* is found in the Pacific Ocean from Japan to Indonesia and eastward into the Indian Ocean.



WORLD BOOK illustration by Colin Newman, Linden Artists, Ltd.

The Pacific bonito lives in the Pacific Ocean.

Some bonitos weigh as much as 24 pounds (11 kilograms) and measure more than 3 feet (91 centimeters) in length. Bonitos have narrow blue lines running from the head toward the back. They have silvery-white undersides and forked tails. Bonitos constantly swim in search of small fishes and squids to eat. A female bonito may produce millions of eggs. The young live in coastal areas and swim out to sea as they grow. Gary T. Sakagawa

Scientific classification. Bonitos belong to the mackerel family, Scombridae. The scientific name for the Atlantic bonito is *Sarda sarda;* the Australian is *S. australis;* the Pacific is *S. chiliensis;* and the striped is *S. orientalis.*

Bonn (pop. 292,234) is a city in west-central Germany. It was the capital of West Germany from 1949 to 1990, the period when Germany was divided into the separate states of West Germany and East Germany. When Germany was reunified in 1990, Berlin was named the official capital of the reunified country. The German government continued to operate from Bonn until the late 1990's. At that time, the majority of government offices and activities began to be moved to Berlin. However, some government headquarters remain in Bonn.

Bonn is the home of the University of Bonn and the birthplace of Ludwig van Beethoven, the famous composer. It lies on the Rhine River, about 20 miles (32 kilometers) south of Cologne (see **Germany** [political map]).

Before World War II (1939-1945), Bonn was a quiet residential town known chiefly for its university. In 1948 and 1949, the city served as the site of the Parliamentary Council, which drafted the West German Constitution. After it became the capital of West Germany, Bonn developed into a major center of government and politics.

The city occupies a beautiful mountain site in the Rhine River Valley. The scenic Seven Mountains rise east of the city. This charming setting and the slow pace of daily life in Bonn give the city the appearance of an overgrown village.

The old section of Bonn is located on the west bank of the Rhine River and includes the main shopping district. Many famous buildings line the narrow, winding streets of this area. The Münster, a Roman Catholic cathedral built during the 1100's, stands in the center of the old section. Nearby is the University of Bonn's main building, which was completed during the early 1700's as a palace for the prince-electors. Its grounds include a large, popular park called the Hofgarten (Court Garden). Several blocks away are the old town hall and marketplace. The Beethoven-House, in which the composer was born, is located near the marketplace.

Adenauer Allee (Adenauer Avenue), which was once called Kobienzerstrasse (Coblenz Street), extends south from the old section of the city. This avenue was once a peaceful, residential street lined with large mansions and gardens. But after Bonn was made West Germany's capital, Adenauer Allee became the hub of major government activities. Schaumburg Palace, which stands on the avenue, became the official residence of the federal chancellor, and the nearby Villa Hammerschmidt became the home and office of the federal president. The avenue remained a center for government offices and activity even after many offices were moved to Berlin in about 2000.

Residential areas are scattered throughout Bonn. Many foreign diplomats had offices and residences near the southern edge of the city in a district called Bad Godesberg. Beuel, a semi-industrial district of Bonn, lies on the east bank of the Rhine River. The Kennedybrücke (Kennedy Bridge) links Beuel with Bonn's old section.

Education and cultural life. The University of Bonn is one of Germany's major centers of learning. An agriculture school operates in the Poppelsdorf Castle, a summer residence of the prince-electors of the 1700's. Botanical gardens beautify the castle grounds.

The Rhenish Provincial Museum in Bonn exhibits collections dealing with the archaeology and history of the Rhineland. The Museum Alexander König has zoological items from Africa, the Arctic, and the Canary Islands. The Beethoven-House, now a museum, displays many of the composer's possessions and furnishings. A concert hall called the Beethoven-Halle includes rooms for lectures and art exhibitions. A music festival honoring Beethoven is held in Bonn in May.

Economy. The federal government employs many of Bonn's people. The city has almost no heavy industry. However, its light industries manufacture such products as ceramics, electrical equipment, furniture, office equipment, pharmaceuticals, and precision instruments. Factories in the Beuel district produce cement and cement by-products. Agricultural products from the area around Bonn are marketed in the city.

Bonn lies on one of Germany's main railroad routes. An international airport, which is located about 15 miles (24 kilometers) north of the city, serves Bonn and Cologne. A six-lane highway links the two cities. Public transportation in Bonn includes buses, subways, and electric trains.

History. Prehistoric peoples probably lived in what is now the Bonn area. The first known inhabitants were the Ubii, a Germanic people who lived there as early as 38 B.C. About A.D. 50, the Romans established a military camp on the west bank of the Rhine. They chose the location to maintain their position on the river against Germanic tribes on the east bank. About 250, two Roman soldiers were executed near the camp for holding Christian beliefs. Bonn was settled near their graves by the Franks, another Germanic people.

Norse invaders destroyed Bonn during the 800's. By 1200, Bonn had been reestablished under the control of the archbishop of Cologne. Bonn served as the seat of the prince-electors of Cologne from 1265 to 1794, when French revolutionary forces seized the city.

In 1815, Bonn and the surrounding territory became part of the kingdom of Prussia. Bonn University was founded in 1818 by the king of Prussia, Frederick William III. The university soon thrived as a center of scholarship. Bonn itself prospered because many wealthy families liked the city's quiet residential character and settled there.

World War I (1914-1918) and political unrest in the Rhineland during the 1920's disrupted the peaceful life of Bonn. During World War II (1939-1945), Bonn suffered heavy damage from air and artillery bombardments.

In 1949, Germany was divided into two separate states, East Germany and West Germany. Bonn became the capital of West Germany. It may have been selected because it lay near Rhöndorf, the hometown of Konrad Adenauer, the first West German chancellor. Bonn was to have been the capital only until Germany was reunified, at which time the government would move to Berlin. Berlin had been the capital and seat of government of Germany before the 1949 division.

Germany was reunified in 1990. Berlin was named the capital of the reunified country, but the country's government continued to operate from Bonn. In 1991, the German Parliament voted to move most government offices and activities to Berlin. The Parliament moved from Bonn to Berlin in 1999, and the offices of Germany's chancellor did so in 2001. Melvin Croan

Bonnard, *baw NAHR,* **Pierre,** *pyair* (1867-1947), was a French painter and graphic artist. In his paintings, Bonnard used vivid colors and rich textures, which give his works a sense of luxury. He particularly liked combinations of orange and yellow, pinks, lavenders, and blues. Bonnard preferred interior scenes bathed in radiant light. Many of Bonnard's interior scenes have figures and an open window looking out over an exotic landscape.

The French painter Paul Gauguin and several other artists influenced Bonnard. He was also influenced by

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Bonn's old town hall stands on a square in the old section of the city. The building was constructed in the 1730's. Today, it is often used as the setting for greeting important visitors to the city and for other ceremonial events.

Japanese screen paintings and the art of popular posters. He adopted the flat compositional design and decorative quality typical of these art forms. Bonnard also became noted for his etchings and lithographs.

Bonnard was born in Fontenay-aux-Roses. In 1888, he entered the Académie Julian, an art school in Paris. There, he joined with several artists, including Maurice Denis, Paul Sérusier, and Edouard Vuillard, in forming a group called the *nabis.* Richard Shiff

See also France (picture: French paintings of the 1900's).

Bonnet, Stede (? -1718), was a retired British Army officer who became a pirate, probably to escape his Barbados Island home. He quietly bought and fitted out a ship, the *Revenge,* and plundered ships along the Carolina, Virginia, and Delaware coasts. For a while, he sailed with the British pirate Blackbeard. According to legend, Bonnet forced his prisoners to "walk the plank" to their death. But there is little evidence that he or any other pirate actually did this. Bonnet's attacks eventually angered the citizens of Charleston, South Carolina, so much that they sent out ships to capture him. He surrendered after an odd battle in which all ships ran aground. He was hanged in Charleston. Robert C. Ritchie

Bonneville, *BAHN uh vihl,* **Benjamin de** (1796-1878), was an American soldier, trader, and explorer. He explored the Rocky Mountains and sent an expedition across the Great Basin, a desert region covering much of what are now California, Nevada, and Utah.

Benjamin Louis Eulalie de Bonneville was born in Paris. He came to the United States in 1803. Bonneville served in the U.S. Army and became interested in trade with the Western Indians for furs. In 1831, he obtained private financial backing for a Western trading expedition. The Army granted him a leave to explore the Rocky Mountain country and California. Bonneville's group set out in May 1832 and returned in August 1835. He failed as a trader, but provided new information about the Great Basin and told the Army of British activities in the Northwest. The Army dismissed Bonneville for overstaying his leave, but Congress reinstated him in 1836 at President Andrew Jackson's request. Bonneville served throughout the West until he retired in 1865 with the honorary rank of brigadier general. William H. Goetzmann

Bonneville Dam, *BAHN uh vihl,* lies on the Columbia River about 40 miles (64 kilometers) east of Portland, Oregon. The dam is 3,463 feet (1,056 meters) wide. It supplies electric power and helps control the river's flooding. For location, see **Columbia River** (map).

Bonneville Dam has two power plants. One plant has 10 generators that can produce 527,000 kilowatts of electric power. The other plant has eight generators that can produce 558,000 kilowatts of power. The Bonneville Power Administration of the United States Department of Energy markets this power, mostly in the Pacific Northwest. It sells excess hydroelectric power to southern California utilities.

There are two locks in Bonneville Dam. The original lock is no longer used. It is listed on the National Register of Historic Places and thus preserved by the U.S. government. A larger navigation lock opened in Bonneville Dam in 1993. It is 86 feet (26 meters) wide and 675 feet (206 meters) long. Ships use it to move between the Columbia River and the dam's reservoir. This lock, and others, allows ships to transport cargo about 460 miles (740 kilometers) from the Pacific Ocean to Lewiston, Idaho.

Waterways called *fish ladders* allow salmon, steelhead, and other migratory fish to swim around the dam on their way upstream to spawn. Special passages built into the dam let the spawned fish pass by the dam on their way to the ocean.

The U.S. government began building the dam in 1933 and dedicated it in 1937. The dam was named for Benjamin Bonneville, a U.S. Army captain. Edward C. Pritchett

Bonney, William H. See Billy the Kid.

Bonobo, *buh NOH boh,* also called *pygmy chimpanzee,* is an African ape closely related to the chimpanzee. It lives in a section of African rain forest south of the Congo River in Congo (Kinshasa).

Despite the name pygmy chimpanzee, bonobos average only slightly smaller than their chimpanzee relatives. Adults weigh from 75 to 100 pounds (34 to 45 kilograms). Bonobos have smaller heads, flatter faces, and longer lower limbs than do chimpanzees. They also possess coal black hair; black faces, hands, and feet; and often pink lips and eyelids.

Bonobos spend much of their time in trees. They dive, hang, jump, and swing acrobatically from branches. The apes have high-pitched voices and may make birdlike sounds. Bonobos also visit the forest floor, and they move along the ground when traveling long distances. Like gorillas and chimpanzees, bonobos usually walk on all fours, supporting the upper part of their bodies with their knuckles. The apes occasionally walk on two legs.

Bonobos live in social groups of about 7 to 10 individuals, which include both males and females. The animals eat mostly fruits, but they also consume other plant foods and animal meat. Bonobo groups may form communities of up to 75 individuals. Scientists believe these groups form only when food is especially plentiful.

The bonobo is an endangered species. Only a relatively small number of bonobos remain in the wild. Peo-

Randall L. Susman

A bonobo resembles its closest relative, the chimpanzee, and is also called the *pygmy chimpanzee.* It has black hair, hands, and feet, and a mostly black face. The lips and rump are usually pink.

ple threaten the apes' survival by destroying their habitat and by illegally hunting them. Randall L. Susman

Scientific classification. The bonobo belongs to the great ape family, Pongidae. Its scientific name is *Pan paniscus*.

See also Chimpanzee.

Bonsai, *BAHN sy,* is the art of growing miniature trees or other plants in containers or on rocks. The word can also apply to the plant itself. *Bonsai* is a Japanese word meaning *potted tree.* The art form originated in China, probably during the early A.D. 200's, then spread to Japan. It gained worldwide popularity in the late 1900's.

There are various ways to start a bonsai. Plants stunted in their natural setting can be transplanted into containers. Growers develop other bonsai from young plants, or from seeds or cuttings. *Conifers* (cone-bearing trees) are favorites, but *deciduous* (leaf-shedding), flowering, and tropical trees are also popular. Other plants used include bamboo and azalea. Most bonsai range from 2 inches to about 3 feet (5 to 90 centimeters) high.

Growers have long used the same methods to care for bonsai. They carefully monitor the plants, and control the intake of water and sunlight. They also use special soils, fertilizers, and feeding schedules. With proper care, bonsai can outlive their creators. Some plants in China and Japan are more than 800 years old.

Bonsai blends natural beauty with art. There are specific styles, such as *formal upright, cascade* (leaning over the container), and *windswept.* These styles developed in China and Japan and reflect forms in nature. Growers prune and repot the plants to create and maintain their shapes. One styling method is to wind wire around the branches to bend them into a desired form. Another is to remove certain branches entirely. Bonsai growers also pinch off new growth. Removing the tips from a plant stunts its growth and strengthens the foliage.

S. Rannels from Grant Heilman

This bonsai azalea has pinkish-purple flowers.

Each plant needs a suitable container. A pot's size should be in proportion to the plant, and the pot should add to the plant's appearance. Most pots are made of fired clay and have specialized shapes. Conifers are usually put into earth-colored containers. Pots for deciduous and flowering trees may be brightly colored to highlight flowers or seasonal hues. Sometimes growers use rocks or rock slabs for unusual trees or plantings made to look like forests. Scott Clark

Additional resources

Liang, Amy. *The Living Art of Bonsai.* Sterling Pub., 1992.
Samson, Isabelle and Rémy. *The Creative Art of Bonsai.* Sterling Pub., 2000.

Bontemps, *bahn TAHM,* **Arna Wendell** (1902-1973), was an African American author who edited or wrote over 30 books about black culture. His works include biography, children's stories, history, criticism, novels, and poetry. He also edited collections of folklore and poetry with his friend Langston Hughes, a black writer.

Bontemps's first book was *God Sends Sunday* (1931), a story about a black jockey. He and Countee Cullen, another black writer, adapted the novel into a musical comedy called *St. Louis Woman* (1946). Bontemps's early novel *Black Thunder* (1936) describes a slave revolt in Virginia. *Drums at Dusk* (1939) deals with a slave revolt in Haiti. His later works include a collection of poetry called *Personals* (1936) and *One Hundred Years of Negro Freedom* (1961), a history.

Bontemps was born on Oct. 13, 1902, in Alexandria, Louisiana. He was a public-school teacher and principal from 1924 to 1938. From 1943 until his death, Bontemps was a professor and librarian at Fisk University, the University of Illinois, and Yale University. William L. Andrews

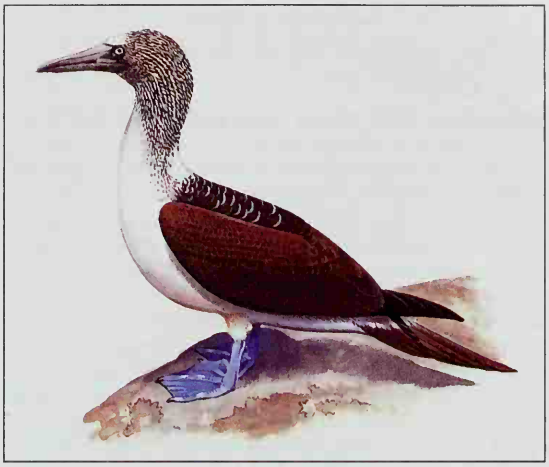
Bonus is a payment in addition to what is due a person, usually an employee. The two main types of bonuses are *incentive bonuses* and *year-end holiday bonuses.*

Incentive bonuses encourage employees to be more productive. In a steel mill, for example, the members of the crew of a blast furnace may each receive a bonus if their output exceeds a certain amount. Some employers give an incentive bonus for completing a job within a specified period. Many salespeople receive such bonuses if their sales during a period exceed a certain amount. Managers often receive them when company sales or profit targets are reached or surpassed. Some labor unions oppose incentive bonuses. They claim that if a worker earns a bonus, the employer will reduce the time allowed for the task involved. The employee would thus have to work harder for another bonus.

Year-end holiday bonuses, also called *Christmas bonuses,* are given to the employees of some companies. The amount of such bonuses often depends on how long a person has worked for the firm. Many employers believe year-end holiday bonuses encourage employees to stay with the company. This helps to reduce the expense of hiring and training new employees.

In another kind of bonus program, called *profit sharing,* employees receive a percentage of the company's profits (see **Profit sharing**). The United States government and many states have given bonuses to war veterans as partial compensation for the higher wages they might have earned as civilians. Daniel Quinn Mills

Booby is any of seven large diving birds that live near warm oceans. The name *booby* comes from the Spanish word *bobo,* meaning *stupid.* Sailors gave boobies this name because the birds would land on ships and were easy to catch. Boobies are related to the pelicans and gannets. Boobies grow up to 2 to 3 feet (60 to 90 centimeters) long with wing spans of more than 5 $\frac{1}{2}$ feet (168 centimeters). They have a pointed tail; a long, sharp bill; and webbed feet. Most boobies are white and brown or white and black. The masked booby, the brown booby, and the red-footed booby are found in warm seas



WORLD BOOK illustration by Trevor Boyer, Linden Artists Ltd.

The blue-footed booby is found along the coast of southern California. Boobies swim as well as fly. They were named *boobies* because they often let themselves get caught by people.

worldwide. They are occasionally seen off the Gulf of Mexico and southern Atlantic coasts of the United States. The brown booby and the blue-footed booby sometimes appear off the coast of southern California.

Boobies eat chiefly flyingfish and squid, which they capture by diving into water from high in the air. Boobies live in flocks on remote islands and coastal cliffs. Depending on the species, they nest either on the ground or in trees and lay from one to four eggs at a time. James J. Dinsmore

Scientific classification. Boobies belong to the booby family, Sulidae. The masked booby is *Sula dactylatra.* The brown booby is *S. leucogaster;* the blue-footed booby, *S. nebouxii;* and the red-footed booby, *S. sula.*

See also **Bird** (picture: Birds of the ocean and the Antarctic).

Boogie-woogie. See Jazz (The swing era).

Book consists of written or printed sheets of paper or some other material fastened together along one edge so it can be opened at any point. Most books have a protective cover. Books are a reasonably inexpensive and convenient way to store, transport, and find knowledge and information. The book thus ranks as one of humanity's greatest inventions.

People have used books in some form for more than 5,000 years. In ancient times, people wrote on clay tablets, strips of wood, or other materials. The term *book* comes from the early English word *boc,* which means *tablet* or *written sheets.* The first printed books in Europe appeared during the mid-1400's. Since then, millions of books have been printed on almost every subject and in every written language. Young readers are familiar with storybooks, textbooks, workbooks, and comic books. We often consult almanacs, dictionaries, encyclopedias, and telephone books for reference. We read novels, books of poetry, and printed versions of plays for entertainment.

Inside a book

The pages of a book are glued or sewed together along one side, called the *spine* or *back.* Two *covers* are joined by *hinges* to the spine. Books are either *hardbound* or *softbound,* depending on the cover. Most hardbound books have covers made of cloth, plastic, or leather over cardboard. A paper *dust jacket* is often added to protect the cover. Softbound books, called *paperbacks,* have paper covers. Usually, the book title and other information appear on a book's spine and front cover as well as on its dust jacket.

Inside the front cover of a typical book is a collection of pages called the *preliminary material.* The material begins with a blank or decorated *end paper,* followed by the *half-title page.* The *recto* (front side) of this page carries the book's title. The *verso* (back of the page) may be blank, or may carry a list of other books by the same

The Kelmscott Chaucer (1896) with illustrations by Sir Edward Burne-Jones; John M. Wing Collection, the Newberry Library, Chicago

A beautiful book is a work of art. During the 1890's, the Kelmscott Press in England produced many books that have been praised for their fine binding, paper, and typography. The press created an edition of the works of the poet Geoffrey Chaucer, *shown here,* that ranks among the masterpieces of bookmaking.

author. The verso is always an even-numbered page and the recto is always odd-numbered.

The *title page* carries the full title of the book and the author's name on the recto. It also carries the imprint, which is the place and date of publication and the name of the publisher or company issuing the book. The verso of the title page contains additional publication information and a statement of *copyright,* which is a notification that the book's contents are the property of the author or publisher. In the earliest printed books, the information now carried on the title page appeared at the end of the book in a statement called the *colophon.* The illustration that faces the title page is called the *frontispiece.*

The *preface* follows the title page. In it, the author discusses aspects of the creation of the book. The *table of contents* usually comes at the end of the preliminary material. It lists in order the book's main topics or the headings of the individual units and their page numbers.

The *text* is the main part of the book. The text is usually divided into separate parts called *chapters* or *books.* The text may also include illustrations. In many books, several sections follow the text. The *appendix* contains notes, charts, tables, lists, or other detailed information discussed in the text. Many books have an *index,* which lists in alphabetical order important subjects, names, and places in the text. The index gives the page number where the reader can find these items in the text. Finally, some books have a *bibliography* that lists sources used by the author in writing the book. The bibliography also lists additional sources on subjects in the text.

Caring for books

All books should be handled carefully. Dropping a book or folding the covers back against each other can break the spine and loosen the pages. To open a new book, place the book on a table with the spine down and gently open the front and back covers. Run your fingers up and down the hinges, where the cover meets the spine. Open the remaining pages a few at a time, working from the front and back toward the middle.

The dust jacket protects the book from stains, dirt, and scrapes, and should remain on the book. You should also protect books against exposure to heat, light, and moisture. Water will stain and warp a book. Water may also dissolve the glue that attaches the pages to the spine, thus causing the pages to come loose. Too much moisture, heat, or light will cause the pages to turn brown and become easily damaged. Moisture can also cause *mildew,* a type of fungus.

Use a bookmark to keep your place in a book. Putting a pencil or other thick object in the book can damage the binding, and folding the corner of a page can cause the paper to tear. Do not underline or write in a library book. The marks may distract other readers and ruin portions of the text. When you photocopy book pages, do not press the whole book flat against the copy plate. That may break the spine. Copy one page at a time, holding half the book over the edge of the copy plate.

When books are not in use, they should be placed upright on a shelf with other books. They should fit closely so they do not lean, which can loosen the binding. When taking a book from the shelf, never pull it by the top of the spine. Grasp the front and back covers together and carefully remove it. When returning a book to the shelf, do not force it in, but make a space for it.

History

Early books. Historians do not know when the first books appeared, but there is evidence that books were written in Egypt as early as 2700 B.C. In Egypt, people wrote on *papyrus,* a writing material made from stems of the papyrus plant that grows along the Nile River. The word *paper* comes from *papyrus.* Egyptian books consisted of *scrolls,* which were long pieces of rolled papyrus. But books were not an invention of any one time or place. For example, in Babylonia (now southeastern Iraq), people wrote by pressing marks into small tablets of clay about the same time the Egyptians were writing on papyrus scrolls. They recorded business and government records, stories, and histories and baked or dried the clay to harden it. About 3,000 years ago, the Chinese made books by writing on long strips of wood or bamboo and tying groups of them together.

By 500 B.C., the ancient Greeks adopted the Egyptian papyrus scrolls as their chief writing material. They also used wooden tablets covered with wax as notebooks. From about 300 to 100 B.C., the Romans adopted the scroll book and wax tablet used by the Greeks.

The gradual replacement of papyrus with *parchment* was an important step in the creation of the modern book form. Parchment is specially treated animal skin. It

Newberry Library, Chicago

The Domesday Book was the first official record of land holdings in England. The survey, written in Latin, was begun in 1085 by order of William the Conqueror.

British Library, London

The oldest known printed book is the *Diamond Sutra,* made in China in A.D. 868. The book consists of seven sheets pasted together to form a scroll. Each sheet was printed from a carved block of wood. The printer spread ink over the raised surfaces on the block and printed the inked images on the paper.

was stronger and smoother than papyrus and lasted longer in the damp European climate. It also cost less than papyrus, which had to be imported from Egypt.

During the first 300 years after the birth of Jesus Christ, early Christians popularized the form of the book called the *codex* (plural *codices*). Rather than joining pieces of papyrus or parchment to make long rolls, they cut the pieces into sheets and sewed them together on one side. They bound the pages with thin pieces of wood or a soft membrane. A codex was easier to use than a scroll because the reader could open it at any page, rather than winding and rewinding it. The codex also provided more writing space, because a person could write on both sides of the page. The codex remains the major form of book today.

The Middle Ages. During the Middle Ages, from the A.D. 400's to the A.D. 1500's, the Christian Church was the center of learning in Europe. Priests and monks working in churches and monasteries preserved the skills of writing and bookmaking. They made books by hand, binding them in codex form. Professional writers, called *scribes,* wrote most books. Much of their work consisted of making copies of religious books, especially the Bible. They also copied some of the great writings of ancient Greece and Rome and wrote new books about Christian history, tradition, and thought.

Some books of the Middle Ages were *illuminated* (decorated) *manuscripts,* with beautiful, colorful designs and pictures drawn on each page. Painters called *illuminators* painted the designs in colors, even in gold. Leather bindings decorated with gold, silver, and precious stones indicated the importance and value of the books. The *Book of Kells,* created in a monastery in Kells, Ireland, is one of the most beautiful of these illuminated manuscripts (see **Manuscript** [picture]).

During the late 700's, the scribes developed a style of writing that made books easier to read. They used capital and small letters, set up a system for punctuation, and left spaces between words. The old Roman writing style used all capital letters and ran all the words and letters together. The new writing style looked much like the type used in modern printed books.

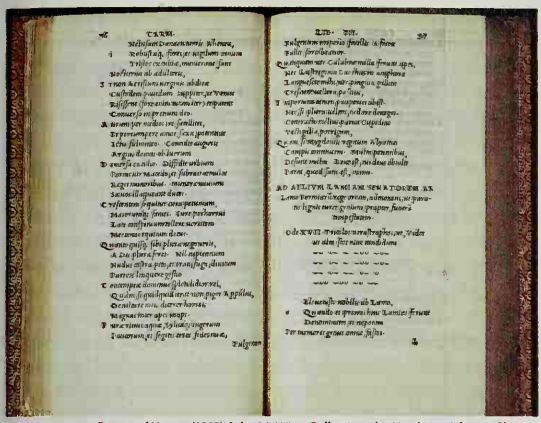
During the 1200's, paper made of cotton and linen began to replace parchment as a writing material. Paper was not as strong as parchment, but it cost far less to make. The idea for making paper probably came from China, where it had been known for more than a thousand years.

By the 1300's, the demand for books began to increase greatly with the growth of a literate middle-class population in cities. People began to look for cheaper and faster ways to make books to satisfy the new market.

The development of printed books. The Chinese made the first known printed book, called the *Diamond Sutra,* in A.D. 868. They carved each whole page from a block of wood, spread ink over the raised surfaces, and printed it on paper. This kind of printing, called *block printing,* appeared in Europe during the late 1300's. People used the technique to produce many copies of playing cards, religious pictures, and other printed materials. They sometimes carved a brief text onto the wood and made books by binding several pages together. With block printing, people could rapidly make more copies of a page than they could make by hand. But they still had to carve each page separately.

The book as we know it today resulted from the invention of printing with *movable type.* In movable type printing, each letter of the alphabet is made out of a separate piece of metal. Printers can arrange the metal type in any combination to produce the text they want. They can also reuse the type. The method allowed printers to produce many different pages in a shorter time than with any previous system of printing.

The Chinese invented movable type using clay during the A.D. 1000's. The Koreans invented metal movable type in the 1300's. Europeans developed movable type independently in the mid-1400's. The first books printed in Europe by movable type appeared in Mainz, Germany, between 1453 and 1456. There, Johannes Gutenberg and his associates worked to develop the printing process. One of the first books printed was a Bible in Latin. This Bible became known as the *Gutenberg Bible,* though Johann Fust and Peter Schöffer probably printed it. They printed about 150 copies, of which 21 complete copies exist. The Bible required six men to set the type and several months to produce. Scholars also call this



Poems of Horace (1509); John M. Wing Collection, the Newberry Library, Chicago

Classic Greek and Latin works, such as the poems of the Roman author Horace, *above,* were published by the early Venetian printer Aldus Manutius. Aldus also invented italic type.

book the *42-line Bible* because most of the pages have 42 lines of type in each column. See **Bible** (picture).

Books printed from about 1450 to 1500 are called *incunabula,* from the Latin word for *cradle.* These books were printed during the infancy of printing. Printers of that time were still strongly influenced by the medieval manuscripts. They used large type resembling the handwritten letters of the earlier books. Early books were printed on fine handmade paper or on a high-quality treated animal skin called *parchment.* Many of the pages were decorated by hand.

Soon after the development of movable type, printers discovered that they could easily include woodcuts and block-printed illustrations in books. Woodcuts became the most commonly used type of book illustration in the 1500's. See **Woodcut.**

The spread of printed books. By the early 1500's, printing had spread throughout Europe. German printers did most of the earliest work. In 1465, two Germans set up the first press in Italy. In 1469, printing was introduced into Venice, which soon became a center for printing and the book trade. A French printer, Nicolas Jenson, started a printing press there in 1470, and became famous as a designer of beautiful type styles. In the 1490's, Aldus Manutius established the Aldine Press in Venice. Aldus became famous for his beautiful editions of classic Greek and Roman works in small and inexpensive volumes. He also invented italic type.

Paris also became an important center of bookmaking in the 1500's. Such printers as Geofroy Tory, Simon de Colines, and the Estienne family made many important advances in printing and illustrating. About 1475, William Caxton produced the first printed book in English, *Recuyell of the Historyes of Troye.* A few years later, he set up the first printing press in England and printed about 100 English books, including Geoffrey Chaucer's *Canterbury Tales.* This was the first printed version of a native English classic.

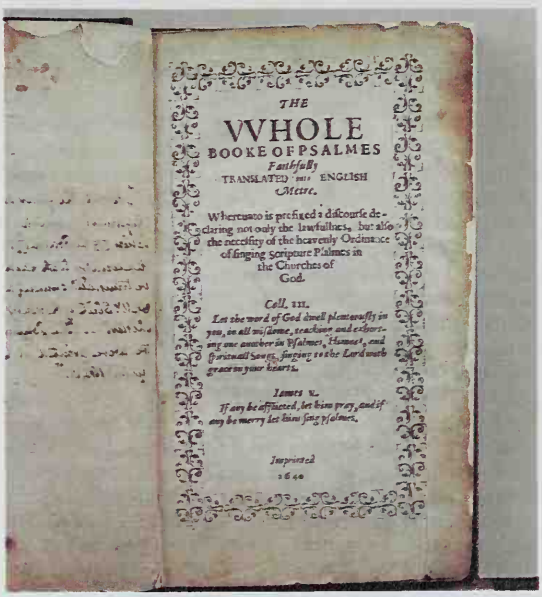
By the late 1500's, books looked much like they do today. Printers had stopped imitating manuscripts of the Middle Ages. They produced smaller-sized books that were inexpensive and easy to carry. Most had a title page, page numbers, a table of contents, and an index.

The 1600's and 1700's. During the 1600's in Europe, the number of people who could read increased greatly. Book printers published large numbers of books, including many small, cheap volumes of the kind first printed by Aldus in the 1500's. There was a general decline in fine design and fewer advances in book design compared to the 1500's. One exception was in book illustration, where technical discoveries in the art of engraving made it a widely used form of illustration. In addition, the Elzevir family of Leiden, the Netherlands, produced many beautiful editions.

During the 1700's, some printers revived interest in fine bookmaking. Such type designers as William Caslon in England and Pierre-Simon Fournier in France produced handsome new type styles that were used by printers for many years. John Baskerville in England and Giambattista Bodoni in Italy became famous for their elegant and well-made books.

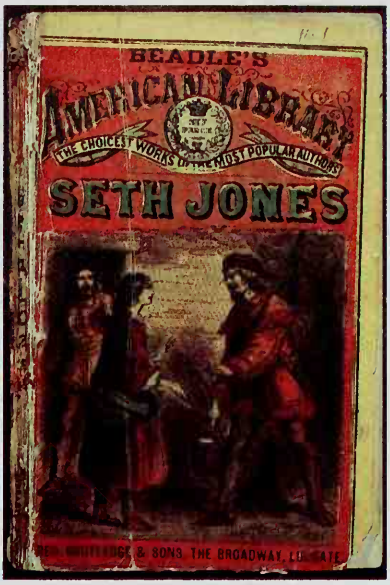
The first printing press in the New World was set up in 1539 in Mexico City. During the 1600's, printing became established in what is now the United States. An English locksmith named Stephen Daye and his son Matthew set up the first printing press, in Cambridge, Mass. The first book from the press was the *Bay Psalm Book* in 1640. By 1763, all of the Thirteen Colonies had printing presses. The best American books of the 1700's came from New York City, Boston, and Philadelphia.

The 1800's. By 1800, the market for books exceeded the number being produced. Printing took much time, because printers had to *set* (put together) the type for each page and print it by hand. Book manufacturing was revolutionized by a number of inventions during the 1800's. One invention was the *Linotype,* which set type mechanically. Other inventions included steam-powered



Trustees of the Boston Public Library (WORLD BOOK photo by Steve Dunwell)

The *Bay Psalm Book* was the first book printed in the English colonies of America. The first edition, *above,* was published in 1640 in Cambridge, Mass. The book consisted of Biblical Psalms.



English paperback novel (1861); Edward E. Ayer Collection, the Newberry Library, Chicago

Paperback books first became popular in Europe and the U.S. in the 1800's. Many early paperbacks were cheaply made, inexpensive editions of novels intended for a mass market.

printing presses and papermaking and bookbinding machines. All these inventions allowed publishers to produce more books at lower cost than ever before. The use of cloth-covered rather than leather-covered bindings also helped keep costs low.

Paperback books became popular in Europe and the United States during the 1800's. A German publishing company named Tauchnitz began to produce paperback editions of the classics in 1841. This series eventually included more than 5,000 titles. In the United States, the first series of paperback editions appeared in 1831. They became extremely successful after 1870. By 1885, a third of the books published were a type of popular paperback called *dime novels* because they originally cost 10 cents. The mass production of books led to a decline in quality. Publishers printed many books on cheap paper. Bindings were often poorly glued, and they broke.

By the late 1800's, several printers dedicated themselves to improving the quality of printed books. The English designer and craftsman William Morris led one such movement to restore the printed book to its old dignity and beauty. In 1890, Morris and some friends established the Kelmscott Press near London. They designed and used styles of type much like those in incunabula. They printed books on handmade paper and bound and decorated them by hand. Other printers also worked to improve their product. Type designers, such as Rudolph Koch in Germany and Frederic Goudy in the United States, developed legible and beautiful types.

Modern books. Paperback books declined in popularity in the early 1900's but made a comeback in the 1930's. Penguin Books, founded in England in 1935, became a world leader in paperback publishing. Pocket Books, now one of the largest American paperback publishers, appeared in 1939. Today, almost two-thirds of all books sold in the United States are paperbacks.

During the 1900's, book publishing became a huge, mechanized industry. Computers now rapidly set type for many books. Books are printed from photographic plates in a method called *offset lithography.* New color printing techniques enable publishers to produce beautifully illustrated books inexpensively. Modern machines print and bind books in a single operation. In the 1980's, computers and desktop publishing began to radically change the way books were being produced.

New types of books include *audio books* or *books on tape,* which are tapes or compact discs of books read aloud. They are used by people on car trips and by people who cannot read, such as young children or the blind. Libraries save space by storing books in small film reproductions called *microfilm* or *microfiche* (see Microfilm). People read these "books" on film readers that enlarge the images. Computers serve as "paperless" books because text and illustrations may be read on computer terminals. Two novels by the best-selling American author Stephen King, *Riding the Bullet* and *The Plant* (both 2000), appeared over the Internet rather than in traditional printed form. The Internet also serves as a distribution system for *e-books* (electronic books). When a reader *downloads* (transfers) an e-book to a special handheld device—or to a computer with special software—the words and pictures appear much as they would on a printed page.

Rudolph Ellenbogen

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Book collecting is a popular hobby. Many people collect books because they love them and enjoy collecting. Some collectors are interested in a subject or author. Others collect books for their beauty. Some people collect books because they hope their books will increase in value and become good investments.

Private book collections have formed the nucleus of some of the world's most important libraries. Many people have also donated their collections to universities where the books may be used for study and research.

There are many types of book collections. The most common include (1) author collections, (2) subject collections, (3) title collections, (4) specimen collections, and (5) format collections.

Author collections concentrate on the works of a single author, such as Mark Twain or Charles Dickens. Some collectors seek only the *first edition* (first printing) of a book. A serious collector might add pamphlets, booklets, or brochures written by the author. Collectors especially prize editions with autographs or inscriptions by the author, and volumes protected with the original *dust jackets* (paper covers). The serious collector might also collect manuscripts or letters from the author.

Subject collections feature books on a particular subject, such as science-fiction movies or ice hockey. Some subject collections are vast, numbering thousands of volumes, but most are much smaller. Collectors of such nonbook items as coins, stamps, or records may also acquire books that deal with their fields.

Title collections consist of as many as possible editions of a single title, including editions translated into various languages. For example, a collector might try to acquire all the editions and translations of the Sherlock Holmes detective novel *The Hound of the Baskervilles.* Some title collections extend to the original manuscript, the edited typescripts, and the printer's proofs.

Specimen collections concentrate on books that are unusually beautiful, rare, or in perfect condition. Specimen collections do not strive for completeness. Instead, the collections may consist of only a few, perfect books. Specimen collections might include books with unique illustrations, books with rare printing styles or type faces, or ancient books. Specimen collections are also called *cabinet collections* because some collectors display them in cabinets.

Format collections are books that share the same shape, size, binding, or other characteristics. Tiny books, comic books, and manuscripts are in this category.

Collecting books. Collectors can find books in rare-book stores, also called *antiquarian-book stores.* Many of these stores will search for books that customers want. Collectors also can buy books from dealers who advertise in magazines. These magazines have lists of books offered for sale and books wanted by collectors. The *American Book Trade Directory* lists antiquarian dealers in the United States and Canada. The directory also shows the fields in which they specialize. In addition, collectors can find books by going to garage sales, second-hand bookstores, and auctions.

A number of elements determine the value of a book for a collector, including its rarity, condition, and age. Books also increase in value if they are first editions, contain inscriptions by the author, or have original dust jackets. Paul H. Mosher

Book of Kells is an *illuminated* (decorated) manuscript of the four Gospels and related material in Latin. Its decorations and its *calligraphy* (beautiful handwriting) make it one of the world's most beautiful books. Its pages measure 13 by 9 inches (33 by 23 centimeters). Some decorated initials occupy a full page.

Scholars are uncertain about the date or place of origin of the book. It was produced between the mid-700's and early 800's, probably in a Columban monastery in Ireland, perhaps the monastery at Kells. The *Book of Kells* is now on exhibition in the Trinity College library in Dublin. Paul Strohm

See also **Manuscript** (picture: *The Book of Kells*).

Book report is a discussion and evaluation of a book, usually as a school assignment. Book reports may be written or oral.

In presenting a book report, you should begin by giving the title, author, publisher, and year of the book's publication. Sometimes it is helpful to give a brief summary of the book to provide a clear idea of its content. The most important part of the report, however, is your opinion of the book. For whom do you think the author is writing? What do you think the author is trying to achieve? How successful is the author, perhaps in comparison with other authors who wrote the same type of book? What are the book's strengths and weaknesses? In answering these questions, you should provide some specific reasons for your position, including details and quotations from the book. You might end the book report by stating your opinion of the overall value of the book.

What you discuss in a book report depends on the type of book you are reviewing. For example, a report on a novel should include information on the plot, the setting, and the characters. It should also evaluate the novel's total effect or meaning. A report on a biography or a historical work should summarize the author's chief points of view. The report should then discuss how convincingly or fairly the author expresses these points of view. William E. Coles, Jr.

See also **Book review.**

Additional resources

James, Elizabeth, and Barkin, Carol. *How to Write Your Best Book Report.* Rev. ed. Morrow, 1998. Younger readers.

Teitelbaum, Harry. *How to Write Book Reports.* 3rd ed. Macmillan, 1998.

Book review is an article published in a newspaper or periodical that announces the publication of a new book, tells what it is about, and evaluates it. The value of a book review depends on the knowledge and ability of the reviewer and on the reviewer's fairness in judging the book. For this reason, the reviewer should have a broad knowledge of the subject of the book under review, the ability to analyze a piece of writing, and the skills to communicate clearly (see **Criticism**).

After stating the title, author, publisher, and price of the book, the reviewer should tell what the book is about and why it is judged to be worthy or unworthy. The reviewer should also discuss its merits and defects and offer a judgment as to how well the author succeeded in accomplishing his or her objectives.

On smaller newspapers and periodicals, one or two people usually handle book reviews. On larger ones, a full-time literary editor assigns most reviews to experts in particular fields. Few newspapers are able to review more than a handful of the books published each week. Even a large newspaper supplement, such as *The New York Times Book Review,* can review or briefly mention only a few thousand of the more than 15,000 general

books that are published annually in the United States.

Many specialized publications review or list books of interest in their fields. The specialized publication offers one of the best routes into larger publications for a potential reviewer. Dianne Donovan

Book Week is a week set aside each year in November to promote the interest of young people in reading good books. Franklin K. Mathiews, a writer of books for boys, and Frederic G. Melcher, a publisher and editor, were responsible for beginning the celebration of National Children's Book Week in 1919.

The first Book Week poster was designed in 1921 by Jessie Willcox Smith, a popular illustrator of children's books. The poster urged "More Books in the Home." Since that time, parents, teachers, librarians, booksellers, publishers, editors, authors, and book reviewers have joined in the Book Week effort to stimulate reading by children.

The Children's Book Council in New York City formulates the plans and procedures for observing Book Week. Several million pieces of printed materials, including more than 50,000 posters, are issued annually to promote the celebration.

Book Week celebrations include exhibits of rare or outstanding children's books at city and school libraries, personal appearances of authors and illustrators at book fairs and autographing parties, television and radio programs, motion pictures, and story hours.

WORLD BOOK photo by Dan Miller

Book Week exhibits encourage young people's interest in reading. Book Week activities are held throughout the United States each year in November.

Book Week observances have contributed greatly to the improvement of books for children. For example, in 1919, only 500 new children's books were published. Today, more than 2,500 are published annually.

Critically reviewed by the Children's Book Council

Bookbinding is the process of putting the pages of a book between covers. Binding holds books together and protects them from wear and tear. It also makes them attractive and easy to use. Bindings range from elaborate, hand-tooled leather to paper. Today, machines bind most books, but some are bound by hand.

Books are either *hardbound* or *softbound*. Most hardbound books have a cover made of heavy paper boards The boards are covered with cloth, leather, plastic, or a combination of these materials. Most softbound books have paper bindings.

How books are bound by machine

Machine bookbinding consists of three main operations: (1) forming, (2) shaping, and (3) covering.

Forming a book. In the first four basic steps of bookbinding, a book is put together in consecutive pages. These steps are (1) folding, (2) tipping, (3) gathering, and (4) sewing.

Folding. Books are not printed one page at a time. Some pages come from the printing press as part of a pile of large, flat sheets of paper. Each side of each sheet usually consists of 2 to 32 different pages of the book that is being printed. The sheet is then fed through a *folding machine*, where a series of rollers or blades fold it several times. The sheet comes from the machine as a *signature* (folded section of a book). The pages of the signature are in the correct order.

Tipping is a method of pasting separate, specially printed pages into a book. A loose page may be put in just before or just after a signature by a *tipping machine*. The machine pastes the loose page along the rear edge of the first or last page of the signature. Tipping by hand is sometimes used to add a separate page in its proper place within a signature. In some books, however, a separate page is simply inserted into a signature without paste. All the pages, including the loose one, are later sewed to one another through their edges.

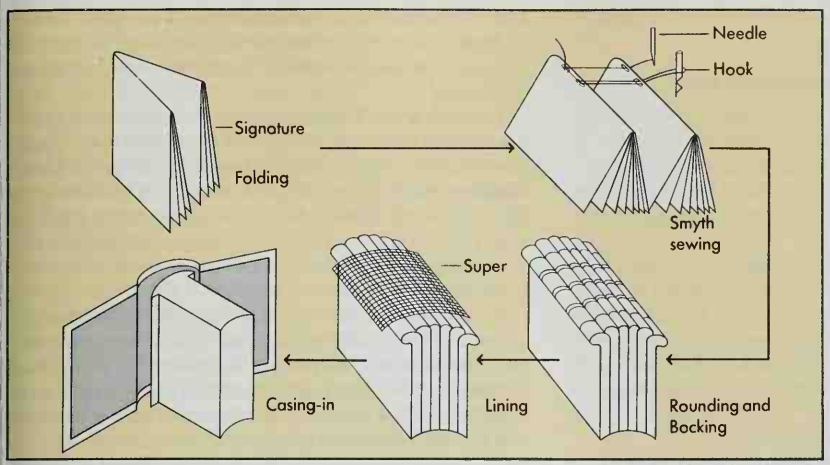
Tipping machines also paste *endsheets* (folded sheets of heavy paper) to the outside pages of some books. In other books, the endsheets form separate signatures that are sewed into place.

Gathering. The signatures of a book are assembled in a *gathering machine*. The signatures are put in consecutive order in a long row of bins on the machine. A chain conveyor passes under the bins. The signatures drop onto the conveyor, one on top of another, until all the signatures of the book have passed the last bin.

The signatures are *collated* (checked) to make sure they have been gathered in the right order. In many books, a small black mark, called a *collating mark,* is printed on the folded edge of each signature to make collating easier. The marks form a diagonal line across the backs of the signatures when they are gathered. A broken line indicates that the signatures are not in the correct order. An inspector can then stop the machine to correct the error.

Sewing. There are two chief methods of sewing books, *Smyth sewing* and *side sewing*. Both methods use strong cotton or nylon thread. Smyth sewing produces a sturdy binding with a rounded back that allows a book to be opened relatively flat. Side sewing is much stronger. It is used for textbooks and other books that receive extra handling.

In a Smyth-sewing machine, a series of needles and hooks pulls threads through the center fold of each sig-



WORLD BOOK diagram by Zorica Dabich

How a Smyth-sewed book is bound

This diagram shows the chief steps in binding a hardcover book by machine. First, sheets of paper are folded into pages. The folded sheets, called *signatures,* are sewed together in their correct order. The spine of the sewed book is rounded, and a hinge is made on each side in a process known as *backing.* A lining of reinforcing mesh fabric called a *super* is then glued to the spine. Finally, the book is joined to its cover, called the *case.*

nature. In this way, the machine sews each signature to the next with a series of continuous threads. At the same time, the pages of each signature are sewn together.

In side sewing, all the signatures are stapled together as the book leaves the gathering machine. A side-sewing machine then drills a series of holes through the sides of the book near the *spine* or *back* (the part of a book that faces out from a shelf). A single needle sews the signatures together from front to back through these holes.

An increasing number of hardbound books and a majority of softbound books are not sewed at all. Most are *perfect bound.* In this process, a machine cuts off the folds of the signatures at the spine. It then roughens the smooth binding edge produced by the trimming and applies a coat of adhesive to it. If the book is to be hardbound, the machine attaches endsheets to the front and back. A separate machine then applies the hard cover, called the *case.* With softbound books, the binding machine pastes a paper cover to the binding edge.

Many softbound books that have fewer than 80 pages are bound with wire stitches. In one form of wire stitching, called *saddle stitching,* signatures are dropped, one over the other, on a saddle stitcher, which drives wire staples through the spine. *Side wire stitching* involves gathering the signatures, one on top of the other, and driving wire staples through the entire book.

Shaping a book consists of four chief steps: (1) smashing; (2) gluing-off; (3) trimming; and (4) rounding, backing, and lining.

Smashing. Smyth sewing makes many books bulge along the spine. A smashing machine compresses books between two steel blocks and gives each book a uniform thickness.

Gluing-off. After smashing, most Smyth-sewed books go through a gluing-off machine, which applies glue to the spine. The glue keeps the threads from unraveling and holds the signatures together.

Trimming. The uneven and folded edges on the three unsewed sides of the book must be cut off. A *book trimmer,* a machine with razor-sharp knives, cuts off the top, front, and bottom edges. The book comes from the trimming machine in its final size. Some books have a decorative coating of gold leaf or gold foil along the top edge or along all three edges. A machine applies this *gilding* after the trimming process.

Rounding, backing, and lining are usually performed by a single machine. First, the machine molds the spine of the book into a rounded shape. Next, it backs the book by making a *shoulder* (hinge) on each side of the spine. These shoulders allow the book to fit snugly in its cover and to open easily. Finally, the machine glues a strip of paper or gauze, called the *lining,* to the spine. Many books have decorated pieces of colored cloth called *headbands* at the top and bottom of their spines. Headbands are usually applied to the lining before it is placed on the book. On most Smyth-sewed books, the machine glues a strip of reinforcing mesh fabric, called a *super,* to the spine.

Covering a book. The binding process is completed with the steps of (1) casemaking, (2) stamping, and (3) casing-in.

Casemaking. The case is usually made separately, in time to be ready for casing-in. Sheets of heavy paper are fed into a cutting machine that trims them to the desired size. The cover boards are then placed in a *casemaking machine.* Precut pieces of cloth or another cover material are fed into this machine. Each piece of material receives a coat of glue on its inner side. As the piece moves through the machine, two cover boards are automatically placed on the glued surface. Heavy paper liners for the spine are placed between the boards. Rollers turn the cover material over the boards, gluing it into place.

Stamping. There are several ways of stamping titles and decorations on book covers. They include embossing; inking; and using foil made of various metals. Another method uses cloth that has been printed before it becomes a book cover.

Casing-in. A casing-in machine joins the book to its cover. This machine applies a coat of paste to the endsheets and also to the extending super, if the book has one. The machine places the book body within the covers and presses the pasted endsheets to them.

After casing-in, the paste is still wet. To make sure that the endsheets stick to the cover boards, the book is pressed. A *building-in machine,* also called a *joint former,* presses the book and forms grooved *joints* or

hinges for the cover boards near the spine. The joints enable the book to be opened easily.

How books are bound by hand

Books are bound by hand for limited or special editions. Most hand-bound books are sturdier than machine-bound books, and many are works of art prized for their distinctive covers. Hand bookbinding is much slower and more expensive than machine bookbinding.

Hand bookbinding has changed little since the 1400's. A craftworker stretches several cords or bands of material to form the spine. The signatures are sewed to these cords or bands, which are in turn sewed into the cover boards. The bookbinder stitches on the headbands and covers the boards with fine leather. Words and decorations are etched on the leather. James R. Niesen

See also **Book; Islamic art** (Books).

Booker T. Washington National Monument was established in 1956 as a tribute to the great black educator, reformer, and writer. It lies near Roanoke, Va., and includes the site of the plantation on which Washington was born a slave in 1856. For area, see **National Park System** (table: National monuments). See also **Washington, Booker T.**

Critically reviewed by the National Park Service

Bookkeeping is the systematic process of analyzing, recording, and summarizing the economic transactions of a business or other organization. Organizations and individuals use bookkeeping because it provides orderly and accurate information about their financial transactions.

Bookkeeping is closely related to *accounting*. Bookkeeping mainly deals with recording and analyzing financial information. Accountants do these activities but also design and install information systems, perform audits, interpret financial statements, and prepare tax returns.

The type of bookkeeping system an organization uses is determined by such factors as the size and nature of the organization and the different kinds of reports that must be prepared. Most small businesses have simple bookkeeping systems, but large organizations usually need more complex systems. Bookkeepers often use special machines and computers to prepare such items as invoices, customer statements, payrolls, and checks. Many organizations have completely computerized their bookkeeping and information systems.

Bookkeeping records and procedures

Accounts. Bookkeepers record all economic transactions in *accounts*. The three basic types of accounts are *asset accounts, liability accounts,* and *equity accounts.* There are also *income* (or *revenue*) *accounts* and *expense accounts.*

Assets are the resources used by an organization. An organization usually owns its assets, which include cash, inventory, supplies, land, buildings, and equipment. Separate accounts are kept for the various types of assets. Liabilities are claims of creditors such as debts owed by an organization. They include accounts payable, wages payable, and mortgages payable and also are generally recorded on separate liability accounts. Equity consists of the claims of owners. Such claims include contributed capital and retained earnings. Income and expense accounts are sometimes called *nominal accounts.* They are considered part of the equity of the organization.

Double-entry bookkeeping. The most commonly used bookkeeping system is called *double-entry bookkeeping.* This system looks at two dimensions of every business transaction. Thus, every account has two sides. One side is the *debit* side, and the other is the *credit* side. Each side has columns for dates, explanations of any changes in the account, and the amount of money involved.

For asset accounts, the beginning balance and all increases are recorded on the debit side. Decreases are recorded on the credit side. This procedure is reversed for liability and equity accounts. That is, the beginning balances and all increases are shown on the credit side, and any decreases are recorded as debits.

Asset accounts

Asset accounts, such as the cash account, shown below, have the beginning balance and any increases on the left side, or debit side. Decreases or credits appear on the right. For liability and equity accounts, the procedure is reversed.

Cash

1987			
June 1 Balance	$8,000	June 15	$3,000
June 8	$4,000		
July 1 Balance	$9,000		

Most transactions in income accounts are reflected as credits. Most transactions in expense accounts are debits.

The fundamental equation in double-entry bookkeeping is *Assets = Liabilities + Equity.* A transaction can affect this equation in many different ways. But the two sides of the equation must always balance each other—that is, they must be equal.

Some transactions increase—or decrease—both sides of the equation. Others affect only one side. For example, the purchase of a machine for $100 in cash will affect only one side, the assets side. This is because the purchase will increase the equipment account, an asset account, by $100 and decrease the cash account, also an asset account, by $100. However, the purchase of a machine for $100 on credit will increase both sides of the equation, the assets side and the liabilities side. This occurs because the purchase will increase the equipment account, an asset account, by $100 and will increase the accounts payable account, a liability account, by $100. In principle, bookkeepers analyze every business transaction in this manner. That is, they check to determine what changes a transaction has caused in the organization's assets, liabilities, equity, income, and expenses.

Many kinds of transactions and events are relatively easy to analyze. But difficult questions may arise in deciding what accounts to debit and credit. For example, there has been disagreement about the proper method of recording an oil company's exploration costs. The pensions earned by an organization's employees also cause bookkeeping problems. Such issues are generally discussed and debated by accountants, not bookkeepers.

Bookkeeping and financial statements. At the end of a specified period of time, such as a month or a year, bookkeepers determine the actual balance in each account. They do this by taking each beginning balance, adding increases, and subtracting decreases. The balance in each account is then listed in a record called a *trial balance.* All debit balances are shown in one column and all credit balances in another. Unless an error has been made, the sum of all debit balances equals the sum of all credit balances.

Accountants use the trial balance to prepare two financial statements—the *balance sheet* and the *statement of income.* The balance sheet shows the totals from the various asset, liability, and equity accounts and thus reflects the organization's financial position at a given date. The income statement, based on the totals for incomes and expenses, reflects the organization's profitability over a given time period. Many organizations also prepare a *funds statement.* This type of statement shows the sources and uses of funds over a certain time period. Bookkeepers use it to explain changes in the balance sheet accounts over two time periods.

Henry Burney
Income statement
For three months ended June 30, 1987

Income		
Income from services		$35,000.00
Expenses		
Rent	$3,000.00	
Wages	7,500.00	
Supplies	8,500.00	
Auto and truck expense	2,500.00	
Office expense	1,850.00	
Telephone	450.00	
Electricity	300.00	
Depreciation of autos and trucks	1,000.00	
Depreciation of tools and equipment	400.00	
Total expenses		25,500.00
Net income		$9,500.00

An income statement shows net profit or net loss by comparing a company's income to expenses for a set period of time.

History

Scholars have traced the origin of double-entry bookkeeping to Italy, where merchants used it during the 1300's. The first known explanation of the system appeared in 1494 in *Summa de Arithmetica, Geometria: Proportioni et Proportionalita,* a mathematics book written by the monk Luca Pacioli and published in Italy.

The first American bookkeeping text was *A New Complete System of Book-keeping by an Improved Method of Double Entry* (1796), written by William Mitchell and published in Philadelphia. Another important step in the development of bookkeeping in the United States occurred in 1880 with the publication of "The Algebra of Accounts," a series of articles by accountant Charles E. Sprague. By the early 1900's, the subject of bookkeeping was incuded in the beginning chapter of many accounting texts. Today, bookkeeping is taught in high schools and vocational schools. Many students also learn the principles of double-entry bookkeeping in basic accounting courses in college.

Careers

Bookkeeping systems are now part of data-processing operations, which provide many career opportunities. Banks, churches, hospitals, political parties, retail stores, and a wide variety of other organizations employ data processors to help keep records of their financial transactions. Important qualifications include the ability to work quickly and accurately with figures and to concentrate on detail.

Beginners handle routine transactions. After gaining more experience, they are given responsibilities involving payrolls and other records. Good data processors have opportunities to advance to jobs on a higher level and, with additional training, to move into accounting departments. Many skilled, experienced data processors hold positions in management.

More and more organizations depend on computers and other machines in the operation of their bookkeeping systems. Therefore, beginning data processors should have a basic knowledge of data processing and know how to operate various office machines. People in this field must continually keep their skills up to date as employers use increasingly complex equipment to handle all aspects of bookkeeping.

Most employers require beginning bookkeepers to be high school graduates. Men and women who plan a career in bookkeeping should take such courses as business mathematics, data processing, and typing. These courses are offered by many high schools, as well as by community and junior colleges and private business schools. Most large firms offer new employees on-the-job training to familiarize them with individual

Henry Burney
Balance sheet
June 30, 1987

** Assets **		** Liabilities **	
Cash	$4,000.00	Accounts payable	$2,700.00
Accounts receivable	3,500.00	Loans payable	1,800.00
Autos and trucks	14,000.00	Total liabilities	4,500.00
Tools and equipments	6,500.00	**Capital**	
Unused supplies	500.00	Henry Burney, capital	24,000.00
Total assets	$28,500.00	Total liabilities and capital	$28,500.00

A balance sheet lists an organization's assets, liabilities, and capital. Total assets must always equal total liabilities plus capital. If the two sums are not the same, a bookkeeping error has been made.

company procedures. Richard P. Brief

See also **Accounting; Calculator.**

Bookmobile is a vehicle that brings library materials and services to people. Bookmobiles, sometimes called *mobile libraries,* are often used in rural or isolated areas and are usually operated by public libraries. A bookmobile may stop at shopping centers, schools, and factories and other workplaces. People can then board the bookmobile to borrow library materials.

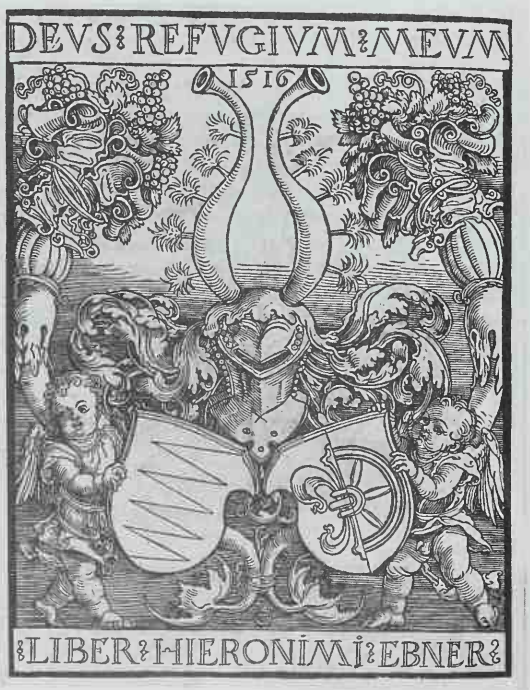
Bookmobiles have existed for many years. However, they have become less important because library services have spread to more isolated areas and other book services have developed. Today, bookmobiles also serve hospitals, housing developments, and other places where library services are limited.

Peggy Sullivan

Bookplate is a printed label pasted in a book as a mark of ownership. The label is sometimes called *ex libris,* which means *from the library* in Latin. Most bookplates are made of paper, but vellum, leather, and other materials are sometimes used. Early bookplates were engraved by hand. Modern bookplates are produced by mechanical processes (see **Engraving**). A simple label printed with the owner's name and address makes a satisfactory, inexpensive bookplate.

The first bookplates were made in Germany sometime after 1475. They were often crude and colored by hand. The earliest known printed bookplate dates from about 1480. Albrecht Dürer designed the first dated bookplate in 1516 (see **Dürer, Albrecht**). For many years, a favorite bookplate subject was the coat of arms of the owner's family. Later designs often represented the owner's interests or occupation. English engravers made bookplates for Americans in the late 1700's.

Many people collect bookplates and books containing bookplates. A number of great artists including Albrecht Dürer, Hans Holbein, and William Hogarth created bookplates. Modern artists who have designed bookplates include Leonard Baskin, Fritz Eichenberg, and Antonio Frasconi. Andrew J. Stasik, Jr.



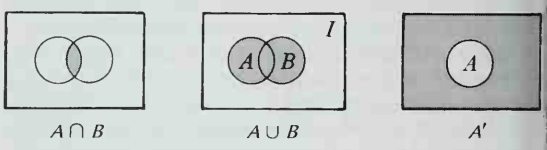
Woodcut from the British Museum, London

Artist Albrecht Dürer designed this bookplate in 1516.

Boolean algebra is a mathematical system used to solve problems in logic, probability, and engineering. The system is named for George Boole, an English logician and mathematician of the 1800's.

Boole developed a system of formulating logical statements symbolically. These statements could then be written and proved in a manner similar to that used in ordinary algebra. Boole's "algebra of logic" also has applications in engineering problems such as the design of electrical switching circuits, particularly circuits that perform arithmetic operations in calculators and computers.

Boolean algebra deals with relationships between *sets* (groups of ideas or objects). Examples of sets are "numbers less than one hundred," "red flowers," and "people." In Boolean algebra, such sets are represented by the letters *A, B, C,* and so on. Three basic Boolean operations follow laws similar to those of ordinary algebra. The symbols for these operations are ∩ ("cap" or "intersection"), ∪ ("cup" or "union"), and ′ ("complement"). For example, the operation $A \cap B$ represents the set of those elements that are in both sets *A* and *B*. This relationship can be represented by the shaded portion of the overlapping circles shown in the first diagram. The operations $A \cup B$ and A' are represented in similar diagrams. The rectangle in each diagram represents a *universal set* (symbol *I*), the totality of all elements being discussed. Alan Shuchat



See also **Set theory; Computer** (History).

Boom. See **Economics** (Economic stability); **Television** (Microphones).

Boom town is a town that has grown up suddenly. As the American frontier moved westward, promoters often chose a townsite where trails crossed or rivers joined. They would lay out a town plan, sell lots, and try to *boom* (promote) the town. A sudden influx of people seeking easy riches produced the typical boom town. It often grew up at the end of the rails as the railroads pushed across the country. Gold and silver strikes attracted miners, merchants, saloonkeepers, and others to a boom town.

Many present-day cities began as boom towns. But some of the townsites never became more than "paper" towns. Others quickly declined into "ghost" towns. Today, a boom town may result from various causes, including the discovery of a vital resource, such as uranium; the rise of a new industry; or, in wartime, the location of a defense project. Duane A. Smith

See also **Western frontier life in America** (Frontier towns).

Benjamin Ruhe Collection (WORLD BOOK photo by Vince Finnigan & Assoc.); Ted E. Bailey

Many boomerangs are made of wood, such as the Australian ones shown above. Nonreturning boomerangs are used as tools and weapons. Returning types are thrown mainly for sport.

Boomerang is a curved, flat implement that is thrown as a weapon or for sport. Most boomerangs are made of wood or plastic. Most boomerangs measure from 12 to 36 inches (30 to 90 centimeters) long and $\frac{1}{2}$ to 5 inches (1.3 to 13 centimeters) wide. Their weight usually ranges from 1 to 18 ounces (30 to 500 grams). Most boomerangs have a bend, called the elbow, near the middle that forms two wings shaped like airplane wings. Boomerangs used for sport typically have two, three, or four wings.

Boomerangs are commonly associated with the Aborigines, the original people of Australia, who use them for hunting and many other specialized tasks. However, scientists believe boomerangs were developed independently by a number of prehistoric hunting peoples. Ancient boomerangs have been found in many parts of the world.

Kinds of boomerangs. There are two kinds of boomerangs, *returning* and *nonreturning*. Returning boomerangs are the best-known type. When a returning boomerang is thrown correctly, the thrower can catch it without moving from the starting point. Different designs of returning boomerangs are made for right- and left-handed throwers. Returning boomerangs are usually smaller than nonreturning types.

Returning boomerangs are used mainly for the sport of boomerang throwing. Throwers can take part in competitions throughout the world. There are several types of events that test a competitor's throwing distance, accuracy of return, and catching ability.

Nonreturning boomerangs have played an important part in Aboriginal culture through the centuries. A spinning boomerang hits a target with more force than a thrown rock or stick. For this reason, nonreturning boomerangs are useful weapons for hunting and fighting. Aborigines have also used them as tools for skinning animals and digging holes, and as trading objects. Some Aborigines decorate boomerangs with carved or painted designs that are related to their legends and traditions. They treat these decorated boomerangs with respect and use them in religious ceremonies. The Aborigines also clap boomerangs together to provide rhythm for songs and chants.

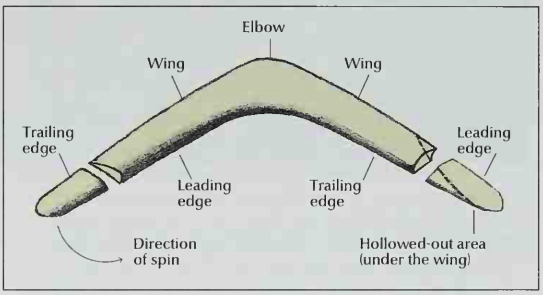
How a boomerang flies. A boomerang's flight depends on its shape and size and how it is thrown. Winds also influence its flight. Each wing of a boomerang has a flat bottom and a curved top. The leading edge of each wing is blunt, and the trailing edge is sharp. As the boomerang spins wing-over-wing in flight, air flows faster along the curved top of the wing than along the bottom. The difference in air speed causes a difference in air pressure above and below the wings, which creates a lifting force that helps keep the boomerang aloft. See **Aerodynamics** (Principles of aerodynamics).

Returning boomerangs are lighter and more curved than nonreturning boomerangs. These features, when combined with highly efficient wings that spin end-over-end in flight, enable the boomerang to travel in a curved, circular path and return to the thrower.

A good throw can make a returning boomerang travel for more than 550 feet (150 meters) before it begins to return. Nonreturning boomerangs can travel for about 650 feet (200 meters).

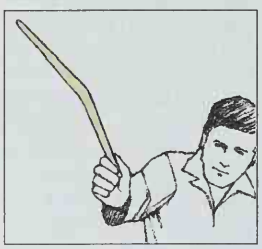
Ted E. Bailey and Chet A. Snouffer

Parts of a right-handed returning boomerang



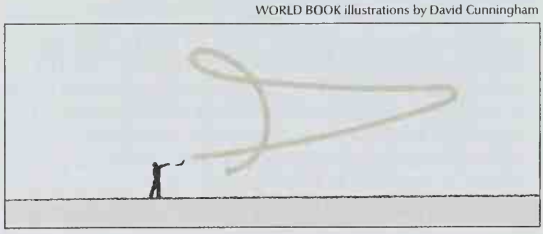
Each wing has a flat bottom and a curved top. When thrown, the boomerang spins forward so the leading edges cut through the air. The hollowed-out area helps the boomerang gain height.

Throwing a right-handed returning boomerang



The right-handed thrower grips the boomerang as shown at the left, with the flat bottom against the palm. The boomerang should lean to the side, as illustrated. A boomerang in flight travels forward, rises, and curves around to one side, as shown below. It rises slightly again before gliding down to the thrower.

WORLD BOOK illustrations by David Cunningham



Daniel Boone Escorting Settlers Through the Cumberland Gap (1851-1852), an oil painting on canvas by George Caleb Bingham; Washington University Gallery of Art, St. Louis

Daniel Boone was one of the most famous pioneers and trailblazers in American history. He helped open the Wilderness Road from Virginia to Kentucky in 1775. This painting shows Boone leading a group of settlers through the Cumberland Gap, a mountain pass on the road.

Boone, Daniel (1734-1820), is one of the most famous pioneers in United States history. He devoted his life to exploring and settling the frontiers of his growing nation. Daniel Boone journeyed through the rugged wilderness of the Appalachian Mountains in 1769 and reached the unexplored area that became known as Kentucky. He cleared the Wilderness Road, a trail that provided a route to the West for thousands of settlers. In 1799, he led settlers into what is now Missouri.

Daniel Boone loved the wilderness and respected the American Indians. But he lived during a time of frequent fighting between the Indians and the frontier settlers. Indians captured him four times. His experience and his knowledge of the ways of the Indians saved many a settler's life and many a fort under attack. He was a top marksman with his favorite rifle, Tick-Licker.

Many people heard of Daniel Boone's deeds and adventures during his lifetime. After he died at the age of 85, pioneering Americans still found in him a source of inspiration. The American author James Fenimore Cooper modeled the memorable hero of *The Leatherstocking Tales* after him. Daniel Boone's role as a wilderness scout also formed a basis for the organization of the Boy Scouts of America during the early 1900's (see **Beard, Daniel Carter**). Today, Boone remains an outstanding example of courage, leadership, and the independent frontier spirit.

Early years. Daniel Boone was born on Nov. 2, 1734, in a log cabin in Berks County, near the present-day city of Reading, Pa. His parents were hard-working Quakers who had a small farm, a blacksmith shop, and a weaving establishment. There was plenty of work for the 11 Boone children. Daniel did his part by helping with the farming. After his father bought additional land some distance from their home, 10-year-old Daniel and his mother went there to live during the grazing season so he could tend the cows. There he began learning the skills that would make him one of the greatest hunters in America.

At about the age of 12, Daniel began to hunt with a rifle his father gave him. He loved the freedom of outdoor life and soon became a skillful woodsman. By practicing with his rifle, he developed a sharp hunter's eye and helped keep his family well provided with meat.

Like most pioneer children, Daniel had little chance to go to school. He did learn to read, write, and use numbers, but his spelling was poor. It improved little during the rest of his life. The letters he wrote and inscriptions he carved on trees after killing bears show that he was a better hunter than student.

In 1750, Daniel's father moved the family to the wild frontier country along the Yadkin River in North Carolina. There, Daniel spent much of his time hunting. He traded the animal skins for lead, gun powder, salt, and other items that the Boones needed.

Tales of a hunter's paradise. In 1755, the British general Edward Braddock came to America and led an expedition to seize Fort Duquesne (now Pittsburgh) from the French. The red-coated British army marched through the Pennsylvania backwoods assisted by American volunteers. Twenty-year-old Daniel Boone was one of the volunteers from North Carolina. He drove a supply wagon.

Among the other wagon drivers was a trader named John Findley (or Finley). John Findley had been to the "wonderful" land of Kentucky beyond the Appalachian Mountains. His stories were of a hunter's paradise, a place where the buffaloes were so big that the meadows sank beneath their weight, and where so many turkeys lived that they could not all fly at the same time.

Daniel listened eagerly to these thrilling tales. From John Findley he learned of the pass through the mountains called the Cumberland Gap, and of the Warriors' Path that led to Kentucky.

Then the French and their Indian allies ambushed Braddock's army. The British troops fled in terror. Boone escaped the ambush with the other wagon drivers. He went home to the Yadkin, but he never forgot Findley's stories about Kentucky.

Marriage. One year after his return from Braddock's expedition, Daniel married Rebecca Bryan, the 17-year-old daughter of his neighbor Joseph Bryan. It was a good match, for Rebecca was a true pioneer woman, with great courage and patience. The Boones had 10 children.

Whenever too many people settled near the Boone cabin, Daniel wanted to push deeper into the woods where hunting was better. Rebecca disagreed only once. That time, Daniel wanted to move to Florida. He had already been there and purchased some land. But Rebecca objected to leaving her family and friends.

Boone in Kentucky. Daniel Boone longed to see Kentucky, but he had to spend most of his time hunting and farming in order to feed his family. In the autumn of 1767, he started westward with his brother Squire and another companion, William Hill. They reached what is now Floyd County in eastern Kentucky. But harsh weather and difficult terrain discouraged them from going further. They returned home in the spring.

The next winter, a peddler came by Boone's cabin. Boone recognized his friend John Findley at once. Findley had again followed the Ohio River into Kentucky. He now talked of trying an overland route that he hoped would increase his fur trade. He described the route to Boone, and told him of his need for experienced woodsman to guide him. Boone would be an excellent choice. So in 1769, Boone and Findley set out for Kentucky. Accompanying them were Boone's brother-in-law John Stuart and three men who kept camp. Boone's brother Squire joined the group later.

Boone wore a fringed hunting shirt that almost reached his knees. He also had deerskin leggings and moccasins. He carried a tomahawk and knife in his belt. From leather straps over his shoulder hung a powder horn and a pouch, filled with lead bullets for the long rifle he carried in his hand. His hair was long, tied in a *queue* (pigtail), and topped with a black felt hat. He never wore a coonskin cap.

Massachusetts Historical Society, Boston (George Cushing)

Portrait of Daniel Boone by Chester Harding was completed shortly before the famous pioneer and trailblazer died in 1820.

Boone headed west from North Carolina and found the Warriors' Path. Indians had used this well-worn, but narrow trail for hundreds of years. The pioneers followed the Warriors' Path through the Cumberland Gap into Kentucky. Boone was overjoyed at what he saw. Vast buffalo herds roamed around the salt springs, and deer and turkeys filled the woods. The meadows were ideal for farming. Boone explored and hunted for two years. During that period, he was captured briefly and released by Indians.

Boone returned to North Carolina. In 1773, he led a group of friends and family members into Kentucky, intending to settle there. But during the trip, Indians attacked a small group of settlers. Only one or two survived. Two boys, including Boone's oldest son, James, were tortured before being killed. The entire party then turned back against Boone's wishes.

The Wilderness Road. Richard Henderson, a North Carolina judge, formed the Transylvania Company in order to establish a new American colony. Boone helped Henderson buy a huge tract of land from the Cherokee Indians in 1775. Henderson then sent Boone and 30 well-equipped woodsmen to improve and connect some of the Indian trails and buffalo paths within

the region. The resulting route reached into the heart of Kentucky. It became known as the Wilderness Road.

That same year, Boone chose a site by the Kentucky River to build a fort. The site was located at the end of Boone's Trace, a branch of the Wilderness Road just south of present-day Lexington. After he built his cabin, Boone brought his family over the Wilderness Road to the fort. Boone's wife and daughter, Jemima, were the first white women to see this part of Kentucky. The fort was called Boonesborough. Boone's village was the main settlement in the region then known as Transylvania. Indians frequently attacked the pioneer forts in Transylvania.

On July 14, 1776, Jemima Boone and two friends, Betsey and Fanny Callaway, went for a canoe ride. The river's strong current pushed the canoe toward the opposite shore. Suddenly, several Indian warriors leaped out from behind the bushes. They dragged the three young women to the shore and silenced them with the threat of scalping. The screams of the captives had been heard at the fort. Boone assembled two groups to track the Indians and their captives. Two days later, Boone caught up with the Indians and directed a surprise attack against them. The three young women were rescued unharmed.

Indian captivity. In January 1778, Boone and 30 other men headed north to get salt deposits for the settlements in a region known as the Blue Licks. One day while he was out hunting alone, Boone was captured by a band of Shawnee Indians. He learned that the large Indian force was planning to attack the unsuspecting salt collectors and Boonesborough. But Boone managed to prevent a massacre by negotiating the surrender of all his men as prisoners. Because of their victory, the Shawnees decided not to attack Boonesborough at that time, thus sparing the lives of many men, women, and children.

The Shawnees forced Boone to run the *gauntlet.* They formed two parallel rows and stood ready to beat him with their weapons as Boone ran between the rows. He escaped serious injury by running in a zigzag pattern. He lowered his head and butted the last warrior in the chest, running over him to safety.

Chief Blackfish favored Boone and adopted him into the tribe as his own son. He gave Boone the name *Shel-tow-ee* (Big Turtle). The Indians plucked all of Boone's hair from his head, except for a *scalp lock* (tuft of hair) on the crown. They took him to the river to "wash away his white blood." He was now a Shawnee brave. Sixteen of Boone's men also became braves. The Shawnees sold the other captives to the British at Detroit.

Escape and battle. Boone acted as if he loved Indian life, but he secretly waited for a chance to escape. When he learned that Blackfish was planning to attack Boonesborough, he could wait no longer. He had to warn his people. The distance to Boonesborough was 160 miles (260 kilometers). In June, Boone escaped and made the long, dangerous trip in four days.

Immediately Boone set the men to work strengthening the fort walls. The women stored food and water inside, and the children molded lead bullets. Then the men stood guard outside the fort and waited. In early September, more than 400 Indians led by Boone's Indian "father" surrounded the fort and demanded surrender.

Conflict of Daniel Boone and the Indians, 1773 (1826-1827), a sandstone relief by Enrico Causici over the south door of the Rotunda in the Capitol; Architect of the Capitol, Washington, D.C.

Boone fought hostile Indians to protect pioneers. Indians captured Boone several times, but each time he escaped.

They greatly outnumbered the approximately 60 men and boys of Boonesborough. But the settlers voted to fight instead of surrender.

Boone delayed the Indian attack for two days by pretending to negotiate a treaty with Blackfish, who, in turn, privately hoped to recapture his "son." When the nego-

Newberry Library, Ayer Collection

Daniel Boone hunted buffalo and other animals with the Indians after he was captured by them in 1778. The Indians admired their captive for his skill as a hunter and woodsman. Boone's knowledge of the frontier and the Indians saved his life.

Newberry Library, Ayer Collection

Boone escaped from the Indians when they surprised him in a tobacco loft in 1782. He jumped down among them, throwing an armful of tobacco leaves. The dust in the leaves choked and blinded the Indians, and Boone fled to the surrounding woods.

tiations failed, the Indians began their attack. They fired their rifles, dug tunnels to the fort, and threw torches against the stockade walls. They also set arrows afire and shot them into the rooftops. Through courage and determination, the settlers survived all these assaults. Nightly rainfall kept the wooden structures damp, so that the fort did not burn. After nine days of steady attacks, Blackfish withdrew.

Four years later, in 1782, the local militia pursued the Indians into the Blue Licks region. They did so against the advice of Boone, who knew the area better than any of the other leaders did. The Indians soon ambushed the group and killed many settlers in a swift and disastrous battle. In this fighting, Boone lost another son, Israel. The settlers were forced to retreat.

Land trouble. By the mid-1780's, Boone was one of Kentucky's richest men in terms of land. He had claimed almost 100,000 acres (40,500 hectares). But he faced trouble that for once he could not defeat. Lawyers sued him because he had failed to get *title* (legal right) to the land he claimed. He moved to Point Pleasant, in what is now West Virginia, and lived there for a few years. Then he brought his family to the Blue Licks region of Kentucky. By 1798, he had lost nearly all his land and was in debt.

Boone in Missouri. In 1799, Boone went west again. He led a group of settlers into Missouri at the invitation of the Spanish governor who controlled the territory. During the journey, someone asked Boone why he left Kentucky. Boone's famous reply was, "Too many people! Too crowded! Too crowded! I want more elbow-room."

The Spanish government awarded Boone a grant of about 850 acres (345 hectares) of land in Missouri. He was also appointed *syndic* (judge) of the Femme Osage district, about 60 miles (100 kilometers) from St. Louis. Boone received much more land after he brought in 100 new families.

He had Spanish title but not American title to his land. When the territory became part of the United States under the Louisiana Purchase in 1803, Boone lost all his land again. The U.S. Congress reissued the original grant of 850 acres in 1814 for his services in opening the West. But Boone had to sell the land in order to pay off debts.

During his later years, Boone continued to hunt and explore the West. When his eyesight became too weak for shooting, he set traps for game. He died on Sept. 26, 1820, at the home of his son Nathan. In 1845, the people of Missouri agreed to have the remains of Boone and his wife moved to Frankfort, Kentucky, the state capital. The Missourians wanted the famous pioneer brought home to his "hunter's paradise." Michael A. Lofaro

See also **Wilderness Road.**

Additional resources

Calvert, Patricia, and others. *Daniel Boone.* Benchmark, 2001. Younger readers.

Faragher, John M. *Daniel Boone.* Henry Holt, 1992.

Hammon, Neal O., ed. *My Father, Daniel Boone.* Univ. Pr. of Ky., 1999. Based on an 1851 interview with Boone's son Nathan.

McCarthy, Pat. *Daniel Boone.* Enslow, 2000. Younger readers.

Boötes, *boh OH teez,* is a constellation in the northern celestial hemisphere. It can be found easily at night because it contains Arcturus, one of the brightest stars in the northern sky.

Boötes is known by several names. It is usually called the *Herdsman* because it seems to guard a fold of animals formed by the nearby stars. Some people call Boötes the *Bear Driver,* because it appears to be chasing the Great Bear and the Small Bear, the constellations Ursa Major and Ursa Minor, across the sky.

Mythology has many stories about the origin of Boötes. In one legend, Boötes is Arcas, the hunter-son of Callisto, the Great Bear. Sumner Starrfield

Booth, Edwin Thomas (1833-1893), ranks among the greatest actors in American theater history. His restrained, subtle style marked a new trend in American acting, replacing the romantic, emotional approach of the previous generation. Booth excelled in thoughtful, tragic roles, such as William Shakespeare's Hamlet. He directed many of the plays in which he appeared and built his own theater in New York City. The theater opened in 1869.

Booth was born near Bel Air, Maryland. He began his acting career while touring with his father, Junius Brutus Booth, an outstanding but eccentric tragic actor. Edwin Booth developed his craft performing in the towns and mining settlements of California. He moved east in 1856 and soon established himself as an excellent performer. In 1864, in New York City, Booth created the most successful Hamlet of his time, setting a performance record of 100 consecutive nights.

The New York Public Library

Edwin Thomas Booth

In 1865, Booth's brother John Wilkes Booth assassinated President Abraham Lincoln. Afterwards, Edwin suffered feelings of personal guilt, and he retired temporarily from the stage. Stanley L. Glenn

Booth, Evangeline Cory (1865-1950) was the first woman to serve as general (director) of the Salvation Army. She was elected to the position in 1934 and served until 1939. She was the daughter of William Booth, the founder of the Salvation Army.

Booth was born in London. She joined the Salvation Army at the age of 15 and began selling *The War Cry,* the army's publication. She began preaching to the poor at the age of 17 and eventually assumed command of the organization's London-area operations. In 1896, the army sent her to Canada to supervise activities there. In 1904, Booth took command of the Salvation Army in the United States, where she worked to expand its social programs and make its structure more democratic. She became a citizen of the United States in 1923. Peter W. Williams

See also Salvation Army; Booth, William.

Booth, John Wilkes (1838-1865), assassinated President Abraham Lincoln at Ford's Theatre in Washington, D.C., on April 14, 1865. He entered Lincoln's private box and shot him in the head during the play *Our American Cousin.* Booth approved of slavery and sympathized with the South in the American Civil War (1861-1865). He believed that Lincoln was responsible for the war.

Bettmann Archive

John Wilkes Booth

Booth was born near Bel Air, Maryland. His father, Junius Brutus Booth, and his brother Edwin Booth were both famous tragic actors, and John himself was one of the most promising performers of the time.

At first, Booth organized a group that planned to kidnap President Lincoln and exchange him for captured Confederate soldiers. Booth changed the plot to murder after the main Confederate army surrendered on April 9, 1865. The group then planned to kill Lincoln, Vice President Andrew Johnson, General Ulysses S. Grant, and Secretary of State William H. Seward. The plotters managed to kill only Lincoln.

After shooting Lincoln, Booth leaped to the theater stage shouting what some understood as *Sic Semper Tyrannis* (Thus Always to Tyrants), the Virginia state motto. Booth broke his leg in the jump but escaped on horseback to Virginia. Federal troops trapped him in a barn near Port Royal, Virginia. There, Booth was shot to death. Gabor S. Boritt

Additional resources

Clarke, Asia B. *John Wilkes Booth: A Sister's Memoir.* Ed. by Terry Alford. Univ. Pr. of Miss., 1996.

Otfinoski, Steve. *John Wilkes Booth and the Civil War.* Blackbirch Pr., 1998. Younger readers.

Samples, Gordon. *Lust for Fame: The Stage Career of John Wilkes Booth.* 1982. Reprint. McFarland, 1998.

Zeinert, Karen. *The Lincoln Murder Plot.* Shoe String, 1999.

Booth, Junius Brutus (1796-1852), was an English actor who gained fame in both the United States and England. Booth was noted for his fiery romantic portrayals of tragic characters, including William Shakespeare's Othello, King Lear, Shylock, and Richard III. Booth's son Edwin became one of America's greatest tragic actors. Another son, John Wilkes Booth, assassinated President Abraham Lincoln in 1865.

Booth was born in London. He achieved his first acting triumph in England in the role of Richard III in 1817. In that year, he briefly established himself as a rival to the great English actor Edmund Kean. In 1821, he sailed for America, where he experienced success as a tragic actor. However, alcoholism and mental illness often disrupted his career. Stanley L. Glenn

Booth, William (1829-1912), an English preacher and social reformer, founded the Salvation Army. The army is a charitable and religious organization dedicated to aiding the needy.

Booth was born in Sneinton, a suburb of Nottingham, and grew up in poverty. At the age of 15, he was converted to Methodism. He became a traveling Methodist preacher in 1852. Booth left the Methodist Church in 1861 to begin a career as a traveling revivalist. In 1865,

he held revival meetings in the slums of London. There, he formed an independent religious organization called the Christian Mission and established facilities to aid the poor. In 1878, he renamed it the Salvation Army.

The Salvation Army took on a semimilitary structure with military ranks and uniforms. Booth was the first general (director) of the army. He organized revival meetings on street corners with stirring music by Salvation Army bands. Many people ridiculed Booth's showmanship and his sympathy for social outcasts and the poor. But the Salvation Army rapidly grew into a religious institution of international importance. Booth's wife and eight children all worked in the army. Two of their children, William Bramwell Booth and Evangeline Cory Booth, served as generals. Peter W. Williams

See also **Salvation Army; Booth, Evangeline Cory.**

Boothia Peninsula, *BOO thee uh,* lies in Canada's territory of Nunavut. It is the northernmost part of the North American continent and is joined to the mainland by Boothia Isthmus. It covers about 12,470 square miles (32,300 square kilometers). Inuit (formerly called Eskimos) come to the peninsula to trade at the Hudson's Bay Post in Spence Bay, on the western side of Boothia Isthmus.

The peninsula was named for Sir Felix Booth, who financed the expedition of Sir John Ross and his nephew, Sir James Clark Ross, in 1829-1833. Sir James Clark Ross discovered the north magnetic pole on the peninsula. The pole is now near Ellef Ringnes Island. For the location of the Boothia Peninsula, see **Canada** (political map). Craig Harper

Borah, William Edgar (1865-1940), an American statesman, was a leader in the United States Senate for almost 33 years. Although a Republican, he was known as a political *maverick* (nonconformist) who rarely allowed party loyalty to determine his stand on issues. Borah became a U.S. senator from Idaho in 1907. He supported many progressive reforms, including the income tax, the direct election of senators, national prohibition, and labor legislation. He favored some New Deal domestic measures. But he opposed American membership in the League of Nations and the World Court, and policies that he feared would involve the United States in World War II (1939-1945).

Borah was born on June 29, 1865, in Fairfield, Illinois. A statue of Borah represents Idaho in the United States Capitol. Robert W. Cherny

See also **Idaho** (Early statehood).

Borax is an important compound of the element boron. It consists of soft, white, many-sided crystals. Borax crystals dissolve readily in water. They will clump together if they are exposed to moist air. The chemical name for borax is *sodium borate* or *sodium tetraborate.* Its chemical formula is $Na_2B_4O_7 \cdot 10H_2O$.

Borax has many industrial uses. Many washing powders, water softeners, and soaps contain borax. Manufacturers mix borax with clay and other substances to make porcelain enamels for sinks, stoves, refrigerators, and metal tiles. Potters use borax to add strength to their products and to make a hard glaze for dishes. Glassmakers mix borax with sand so that it will melt easily and produce strong, brilliant glass. Glass cooking utensils and thermometers are made from glass that contains borax. Borax is also used in the textile industry, in tanning leather, and in the manufacture of paper.

U.S. Borax

Borax is mined using the open-pit method. Miners strip away the ground above the borax bed. Then they blast the borax loose and remove it layer by layer. Most of the world's borax is mined in Death Valley in California and in the Mojave Desert.

Most of the world's supply of borax comes from Death Valley in southern California. Borax is also taken from open-pit mines in the nearby Mojave Desert, where miners strip away the covering ground to expose the borax bed. Workers use explosives to blast loose the solid borax. The large chunks of borax are crushed and dissolved. This solution goes through many purification steps until borax crystals are obtained.

Borax is also obtained from "dry" or "bitter" lakes. The brine, which contains many salts other than borax, is pumped from the lake into containers. The solution is allowed to stand in vats to separate the borax from the heavier salts, which sink to the bottom. The remaining brine crystallizes, and the borax is refined.

Another major source of commercial borax is a mineral called *kernite.* Large deposits of this mineral, which consists of about 75 percent pure sodium borate, are found in the Mojave Desert. Borax is obtained from kernite by dissolving the mineral in water, filtering off impurities, and then allowing it to recrystallize.

Tibet is said to have been the first important source of borax. Since the 1920's, the United States has produced most of the world's borax. Robert J. Ouellette

See also **Boron; Death Valley.**

Borazon, *BAWR uh zahn,* is an artificially produced crystal that has the hardness of a diamond. It may be used in industry as an abrasive for shaping the hardest materials. Borazon can withstand temperatures of more than 3500 °F (1927 °C), while diamonds burn at 1600 °F (871 °C). Borazon is the only substance that can scratch a diamond. Diamonds can also scratch Borazon.

Borazon is made of equal numbers of atoms of the

elements boron and nitrogen. To make Borazon, chemists heat boron and nitrogen at 3300 °F (1816 °C) under a pressure of 1 million pounds per square inch (70,000 kilograms per square centimeter). The substance was first produced in 1957 by Robert H. Wentorf, Jr., a physical chemist for the General Electric Company. In 1969, General Electric officially adopted the name *Borazon* as a trademark for the substance. Clark L. Fields

Bordeaux, *bawr DOH* (pop. 218,948; met. area pop. 753,931), is a commercial city in southwestern France. It stands on the banks of the Garonne River. For location, see France (political map).

Bordeaux lies in the Aquitaine basin, a region covered with vineyards. It produces many famous wines and is France's leading center of wine shipping. It has a large natural harbor on the Garonne River. The river links the city with the Bay of Biscay—an arm of the Atlantic Ocean. In addition to wine making and shipping, Bordeaux's economic activities include chemical production, fishing, oil refining, shipbuilding, and the manufacture of aeronautical and electrical equipment and wood products. Bordeaux is the capital of the Aquitaine region and the Gironde *department* (administrative district). The city's landmarks include the Tower of St. Michel, which dates from the 1400's; the University of Bordeaux, founded in 1441; and the Grand Theater, built in the 1700's.

Bordeaux was an important city in the Roman Empire. England occupied the city from 1154 to 1453. In 1940, during World War II, Bordeaux served as the last seat of the Third Republic, the government then in existence in France. Mark Kesselman

Borden (pop. 798) is the main port of entry to the Canadian province of Prince Edward Island. It lies on the Northumberland Strait, about 40 miles (64 kilometers) west of Charlottetown. For location, see **Prince Edward Island** (map). Confederation Bridge connects Borden and Cape Tormentine, on the New Brunswick mainland. This toll bridge, which opened in 1997, extends about 8 miles (13 kilometers) across the Northumberland Strait. The town, formerly called *Port Borden,* was named for Sir Robert Laird Borden, prime minister of Canada in the early 1900's. In 1995, the town annexed two areas called Carleton and Carleton Siding and became officially known as Borden-Carleton. Borden-Carleton has a mayor-council form of government. Walter MacIntyre

Borden, Lizzie (1860-1927), was the defendant in one of the most celebrated murder trials in United States history. She was accused of killing her father and stepmother with an ax. A jury found her not guilty.

Lizzie Borden was born on July 19, 1860, in Fall River, Massachusetts. She was the youngest daughter of Andrew J. Borden, a banker, and Sarah Morse Borden. Sarah died when Lizzie was 2 years old. Two years later, Borden married Abby Gray, whose father was a tin peddler. Lizzie grew up with an elder sister, Emma. The sisters scorned their stepmother, partly because of her family's inferior social position.

Brown Brothers

Lizzie Borden

The bloody corpses of Andrew and Abby Borden were found on Aug. 4, 1892. Suspicion fell on Lizzie, who had the best opportunity to commit the crime. Lizzie had been active in charitable and religious groups, and many wealthy townspeople, women's rights organizations, and other groups supported her. Many other people felt sure of her guilt. The case attracted national attention.

The trial began on June 6, 1893. Defense witnesses told of Lizzie's good reputation. The prosecution presented evidence that Lizzie hated her stepmother, resented her father's gifts to Abby's relatives, and tried to buy poison the day before the murders. Lizzie Borden has been the subject of books, a ballet, a ballad, and plays. Lizzie died on June 1, 1927. Mary S. Hartman

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Bordeaux lies along the Garonne River in southwestern France. Large oceangoing vessels sail up the river to load and unload cargo at Bordeaux. Fine wines are produced in Bordeaux, and the city is the leading French center of wine shipping.

Sir Robert L. Borden

Robert Laird Borden.

Prime Minister of Canada
1911-1920

Laurier 1896-1911 | **Borden** 1911-1920 | **Meighen** 1920-1921

Detail of a portrait by Kenneth Forbes; House of Commons, Ottawa (John Evans)

Borden, Sir Robert Laird (1854-1937), served as prime minister of Canada throughout World War I. As prime minister from 1911 to 1920, Borden made his greatest achievements in helping Canada win a more independent role in world affairs. He believed that his country should support British Empire policies, but only if Canada had an "adequate voice" in making the policies. Borden's government also reformed the Canadian civil service and gave women the right to vote in national elections.

Borden led the Conservative Party from 1901 until he retired as prime minister in 1920. Under his strong leadership, the Conservatives defeated the Liberals in the 1911 election after being out of power for 15 years. The Liberals, under Sir Wilfrid Laurier, had ruled Canada since 1896.

A sturdy man, Borden had a cheery, dogged courage. He had a bristling mustache and parted his long, silver hair in the middle. The effect made him look lionlike. Although a lawyer by profession and accustomed to public speaking, he was not a great orator.

Borden entered public life reluctantly in 1896. He would have preferred to remain a lawyer. A few years later, when the Conservatives asked him to lead their party, he at first refused. He eventually accepted, however, because of his sense of duty, and he came to appreciate his position of leadership.

Early life

Robert Laird Borden was born on June 26, 1854, in the village of Grand Pré, N.S. He was the eldest of the four children of Andrew Borden and Eunice Jane Laird Borden. His father, who was a farmer at the time of the boy's birth, later became a railroad stationmaster.

Borden's ancestors came from England and Scotland by way of New England. One had landed in Rhode Island in 1638. The families of both his parents had moved to Nova Scotia from New England in the 1700's.

Robert grew up in the Gaspereau Valley, one of the most beautiful regions of Canada. In the winter, Robert went sledding with his friends on the snowy hillsides. The boy attended the Anglican (Episcopal) Church with his father, and sometimes the Presbyterian Church with his mother.

He went to the local school, known as the Acacia Villa Seminary. Robert did especially well in Latin, Greek, and mathematics. This pleased his mother, whose father had been a student of ancient languages. Borden was such a good student that in 1869, when only 14, he became a teacher at the school. In 1873, he accepted a position at a school in Matawan, N.J., and taught there for about a year.

In 1874, Borden returned to Canada and decided to become a lawyer. Nova Scotia had no law school at that time, so Borden studied law as a clerk in a Halifax law firm. He was admitted to the bar in 1878. Borden began practicing law in Halifax and then in Kentville, N.S. In 1882, he joined the Halifax firm of Graham, Tupper, and Borden as a junior partner. Important cases took Borden before the Supreme Court of Canada and even before the Judicial Committee of the Privy Council of Britain. This committee was the final court of appeal for nations belonging to the British Empire.

On Sept. 25, 1889, Borden married Laura Bond of Hali-

fax. Borden spoke of his wife as the person "whose devotion and helpfulness . . . have been the chief support of my life's labours." The Bordens had no children.

Early public service

Entry into politics. Borden had been brought up as a Liberal, but he left the party in 1886. He did so because the Liberal leader in Nova Scotia had called for the possible withdrawal of Nova Scotia from the Canadian federation. In 1896, the Conservative Party was desperately looking for new people. Halifax Conservatives thought Borden would be an excellent candidate.

Borden was reluctant to enter politics. "At first I flatly refused," he wrote later. "I had no political experience; no political ambitions had ever entered my mind and I was wholly devoted to my profession."

Borden finally agreed to run for Parliament. He won election even though the Conservative government of Prime Minister Charles Tupper was defeated.

Borden had some difficulty adjusting to his new surroundings. "The nervous strain of learning to speak in parliamentary debate I found rather severe," he wrote, "although for many years I had been accustomed to speak in court and before juries."

Conservative leader. In 1900, Borden was reelected to Parliament. But the Conservative Party again met defeat. In 1901, Sir Charles Tupper, the father of Borden's law partner, resigned as Conservative leader. The party asked Borden to be the new leader. Borden again refused at first, but the Conservatives did not give up. "Finally," he wrote later, "under great pressure, I agreed to accept the task for one year. . . ." Borden led the party for 19 years.

Borden faced a difficult situation that tested his courage and his capacity to work. The Liberals had come to power in 1896 under Wilfrid Laurier, a brilliant French-Canadian orator. Canada had prospered during Laurier's rule, and immigrants and money were coming in from

Important dates in Borden's life

1854 (June 26) Born in Grand Pré, N.S.
1889 (Sept. 25) Married Laura Bond.
1896 Elected to Parliament.
1901 Elected leader of the Conservative Party.
1911 (Oct. 10) Became prime minister of Canada.
1914 Knighted by King George V.
1917 Helped organize Imperial War Cabinet in London.
1917 (June 11) Introduced Military Service Bill for conscription. Parliament passed it on July 24.
1917 (Oct. 12) Formed the Union Government.
1919 Led Canadian delegation to peace conference at Versailles, France.
1920 (July 10) Resigned as prime minister.
1921-1922 Delegate of the British Empire at Washington Conference on naval disarmament.
1924-1930 Served as chancellor of Queen's University.
1937 (June 10) Died in Ottawa, Ont.

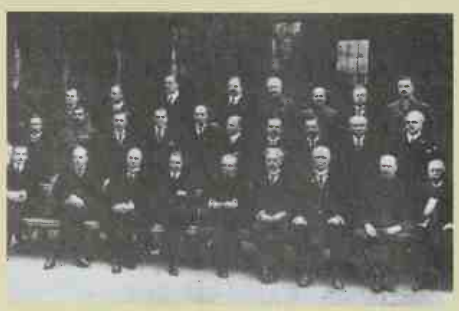
WORLD BOOK illustrations by Tak Murakami

Important events during Borden's Administration

Public Archives of Canada

Canadian troops in France gave a hearty welcome to Borden, *right,* during his World War I tour overseas.

The Union Government, formed in October 1917, was made up of Conservatives and Liberals who favored *conscription* (drafting men for military service).



Public Archives of Canada

Borden served in the Imperial War Cabinet in World War I. He is in the front row, fourth from the right.

Manitoba | Saskatchewan | Nova Scotia | Prince Edward Island

The conscription plan divided French- and English-Canadians. But most voters supported it.

New Brunswick | Alberta | Ontario | British Columbia | Quebec

abroad. In addition, the country's programs of land settlement and railway-building had been successful under the Liberals.

Borden set out to rebuild the discouraged and divided Conservative Party. His task was slow and painstaking, and by the 1904 election he had not succeeded. The Liberals won the election, and Borden himself was defeated for reelection to Parliament from Halifax. In 1905, he was reelected from Carleton, Ont. That same year, Borden gave up his law practice and moved to Ottawa. He felt he could carry on his duties as leader more effectively in the Canadian capital.

A new Conservative program. In 1907, Borden announced a new program for the Conservative Party. He had been influenced by the progressive ideas of the Conservative governments of Manitoba and Ontario and of American progressives. Borden called for public ownership of the telephone and telegraph systems, and of certain railways and grain elevators. He favored closer supervision of immigration and a protective tariff on imports to protect Canadian goods.

In the 1908 election, the tide began to turn in Borden's favor. He won election to Parliament from both Halifax and Carleton, and decided to represent Halifax. The Conservatives picked up strength in the election while the Liberals lost support in Quebec and Ontario. More and more French Canadians thought Prime Minister Laurier too "British" in his policies. More and more English Canadians thought he was too "French."

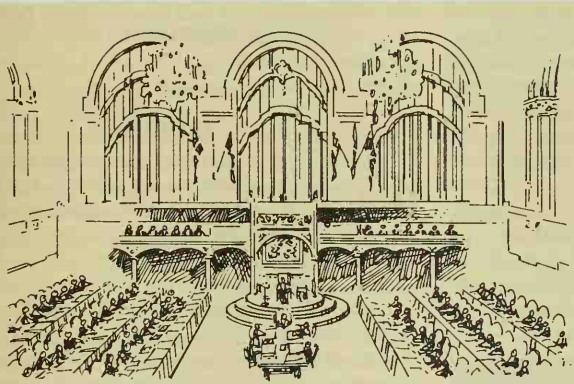
Laurier's two biggest problems gave Borden his chance to become prime minister. These problems were Canada's relations with Britain and with the United States.

The major problem in Canada's relations with Britain was the question of what Canada's role would be in any major war fought by the British Empire. British leaders believed that a war was likely with Germany. They thought Canada should raise troops and build ships to serve as part of the British forces. But Laurier felt Canada should have its own troops and ships. He also believed that the Canadian Parliament should decide when and if they should be used. In 1910, Parliament passed the Naval Service Bill to begin building a Canadian navy. Borden attacked the bill as ineffective in view of the international emergency. He felt it would take too long to build a Canadian navy. He wanted to send money to Britain for the immediate building of ships.

The main problem in Canada's relations with the United States centered around a reciprocal trade agreement between the two nations. Borden opposed this agreement, which had been arranged by Laurier's government in 1911. Borden believed that such close trade relations with the United States would endanger Canadian independence.

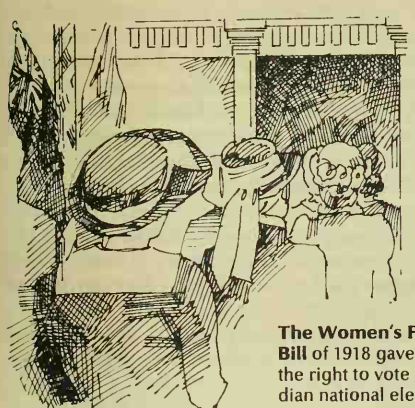
The naval bill and the trade pact became the main issues in the 1911 election. The Conservatives won their

WORLD BOOK illustrations by Tak Murakami



The Canadian Civil Service underwent reform in 1918 when Parliament passed a bill that eliminated all patronage.

The Paris Peace Conference of 1919 drew up treaties ending World War I. Borden insisted on independent Canadian representation at the conference.



The Women's Franchise Bill of 1918 gave women the right to vote in Canadian national elections.

first victory in 15 years, and Robert Borden became prime minister of Canada.

Prime minister (1911-1920)

The 57-year-old Borden took office as prime minister on Oct. 10, 1911. He had to deal immediately with the question of Canadian military aid to Britain. Borden said Canada would help Britain in a major war. But he demanded that Britain give Canada what he called an "adequate voice" in making British Empire policy. The British government refused.

In 1912, Borden introduced his Naval Aid Bill in the House of Commons. This bill provided money to build warships for the Royal Navy. After weeks of heated debate, the House passed the bill. But the Senate, still controlled by the Liberals, defeated the Naval Aid Bill in 1913. King George V knighted Borden in 1914.

War leader. Borden's career reached its height during World War I. When the war began in 1914, Canada had neither built its own navy nor given ships to Britain. Canada went to war as part of the British Empire. For two years, Borden's government raised, equipped, and sent to France the units that became the Canadian Corps. These units fought under Canadian command. By 1917, Canada had grown into a military power. Borden had achieved great influence among the leaders of the British Empire.

The time had come, Borden felt, to press for a greater share in policymaking. From February through May 1917, he helped organize the Imperial War Cabinet in London. This group consisted of the prime ministers of all the British Dominions. During the next two years, the Imperial War Cabinet helped plan the conduct of the war. The prime ministers also made plans for the peace that would follow the war. Members of the British Empire worked together as never before. Much of the success was due to the influence of Sir Robert Borden. He had achieved his "adequate voice."

Conscription crisis. Later in 1917, Borden returned home to serious military problems. Canada had lost many men in battle, and replacements were needed. Until this time, all Canadian servicemen had enlisted voluntarily. Borden believed that *conscription* (drafting men for military service) was now necessary to keep the Canadian forces up to strength.

"All citizens are liable to military service for the defense of their country," Borden told Parliament, "and I conceive that the battle for Canadian liberty and autonomy is being fought today on the plains of France and of Belgium."

Most French Canadians, including Sir Wilfrid Laurier, leader of the Liberal Party, opposed conscription. To keep unity among all Canadians, Borden wanted conscription approved by both parties in a Union Party government if possible. Laurier refused to join the proposed party. However, many Liberals in Ontario and Canada's western provinces opposed Laurier and joined Borden's Unionist group. With their support, Borden formed the Union Government in October 1917.

Parliament had already passed a Military Service Act providing for conscription. Farmers and labor unions opposed it. Many French Canadians in Quebec rioted in protest. The proposed draft caused a serious split between English-speaking and French-speaking Canadians. But in the December 1917 elections, the majority of voters approved the government's action.

Postwar achievements. In November 1918, Borden went to Europe. As the leader of Canada's delegation to the peace conference at Versailles, France, his most important goal was to win public recognition of Canada's new position in world affairs. Borden insisted that Canada have separate representation at the conference. Many British delegates at the conference wanted the British Empire to act as a unit. But Borden had his way. The dominions had their own representatives as though they were independent countries.

When the conference formed the League of Nations, a forerunner of the United Nations, Borden again insisted that Canada be a member in its own right. Canada also became an independent member of the International Labor Organization, an agency of the League of Nations that promoted the welfare of workers.

In May 1918, the Canadian Parliament passed a bill that reformed the nation's civil service. The bill eliminated all patronage connected with the civil service (see **Patronage**). The Union Government also passed a bill that gave women the right to vote in Canadian national elections.

Sir Robert's health had suffered because of his constant hard work during the war years. He was close to exhaustion, and doctors told him to rest. But he continued to work. By late June 1920, he knew he had to retire from office. "I soon discovered," he admitted, "that I had reached the end of my strength, and I quickly realized that my public career was drawing to an end." Borden resigned as prime minister on July 10, 1920. His followers chose Arthur Meighen to take his place as their leader and prime minister.

Later years

"In looking over my diary for 1920, for the period following my retirement," Borden wrote in his *Memoirs,* "I find that very frequently I have set down my satisfaction at my release from public life, as well as my conviction that it would take me a long time to recover fully my health and strength."

A long, productive retirement lay ahead for Borden. In 1921-1922, he was a delegate of the British Empire at the Washington Conference on naval disarmament. Also in 1921, Borden delivered the Marfleet Lectures at the University of Toronto. These were published in 1922 as *Canadian Constitutional Studies.* In 1927, he gave the Rhodes Lectures at Oxford University. These were published in 1929 as *Canada in the Commonwealth.* While prime minister, Borden had been chancellor of McGill University in Montreal. From 1924 to 1930, he served as chancellor of Queen's University in Kingston, Ont.

Sir Robert lived in Ottawa during his retirement. During his last years, he wrote and revised the story of his life. His *Memoirs* were published in 1938 by his nephew, Henry Borden. Sir Robert died on June 10, 1937. Lady Borden died on Sept. 7, 1940. Both are buried in Ottawa. John English

Related articles in *World Book* include:

Canada, Government of
Canada, History of
Laurier, Sir Wilfrid
Meighen, Arthur
Political party (Political parties in Canada)
Prime minister of Canada
Tupper, Sir Charles

Additional resources

Brown, Robert C. *Robert Laird Borden.* 2 vols. Macmillan, 1975, 1980.

English, John R. *The Decline of Politics: The Conservatives and the Party System, 1901-1920.* 1977. Reprint. Univ. of Toronto Pr., 1993.

Border collie is a breed of dog commonly used to herd sheep. It received its name because it originated near the border between England and Scotland in the 1700's. The dog weighs 30 to 50 pounds (14 to 23 kilograms) and grows 18 to 22 inches (45 to 56 centimeters) high. Its thick coat is usually black with white markings on the face, neck, legs, and tail. Border collies are intelligent, athletic dogs. They make loyal, affectionate pets but need much exercise and attention.

© Lori Davidson

The border collie makes a loyal and affectionate pet.

Critically reviewed by the American Kennel Club

Border Patrol, United States, is an enforcement agency within the Immigration and Naturalization Service. It operates along United States land borders and in coastal areas of Florida and the Gulf of Mexico. Its main purpose is to prevent the unlawful entry of *aliens* (foreigners) into the United States. It also works to intercept illegal drugs being smuggled into the country. Border Patrol officers are trained at the Border Patrol Academy in Glynco, Georgia. They learn immigration laws and related subjects, methods of operation, the Spanish language, and law enforcement. See also **Illegal alien.**

Critically reviewed by the Immigration and Naturalization Service

Border state. See **Confederate States of America.**

Border terrier is one of the oldest English breeds of terriers. The dog comes from the border country of northern England. It has a slim body and a broad, flat head with turned-down ears. Its wiry coat may be red and tan, blue and tan, or golden brown. For dog shows, the American Kennel Club requires border terriers to weigh from 11 $\frac{1}{2}$ to 15 $\frac{1}{2}$ pounds (5 to 7 kilograms).

Critically reviewed by the Border Terrier Club of America

Borg, Bjorn, *byawrn* (1956-), became one of the greatest players in the history of tennis. Borg was the only player in modern tennis history to win the men's singles title at the All-England (Wimbledon) Championships five straight times. He won the tournament in 1976, 1977, 1978, 1979, and 1980.

Borg's most effective shot was his forehand, but he also had a skillful two-handed backhand and a strong serve. He showed a remarkable ability to hit winning shots from anywhere on the court. Borg's calm manner earned him the nickname "The Iceman."

Bjorn Rune Borg was born on June 6, 1956, in Södertälje, Sweden. In 1976, he took the Wimbledon title without losing a set and also won the World Championship of Tennis (WCT) title. Borg won the French Open tournament in 1974, 1975, 1978, 1979, 1980, and 1981; the Italian Open Tournament in 1974 and 1978; and the Masters Tournament in 1980 and 1981. In 1983, he retired from tournament tennis. Arthur Ashe

Borges, *BAWR hehs,* **Jorge Luis,** *HAWR hay loo EES* (1899-1986), was an Argentine man of letters. He won international acclaim for his distinctive *fictions,* which were short stories with many features of the essay. In addition to his fictions, Borges's major accomplishments were the complex beauty of his literary language, his ability to turn philosophical topics into literature, and his insights into the organization of the mind.

Borges was born on Aug. 24, 1899, in Buenos Aires, Argentina. In the 1920's, he founded the city's *avant-garde* (experimental art movement) and was an innovative poet. He then had a change in outlook and spent the 1930's writing prose while developing his variation of the short stories. The collections *Ficciones* (1944) and *The Aleph* (1949) reflected the successful results of this process. He then shifted among poetry, nonfiction, and narrative prose, producing a large body of work. Of his later writings, the stories in *Doctor Brodie's Report* (1970) aroused the greatest interest for their apparently plain narrations capable of being understood in different ways. His *Collected Fictions* was published in 1998, after his death on June 14, 1986. Naomi Lindstrom

Borgia, *BAWR juh,* **Cesare,** *CHEH zah reh* (1475?-1507), was an Italian political leader and a cruel, ambitious man. His ruthlessness attracted the attention of Niccolò Machiavelli, an Italian political thinker. Machiavelli's book *The Prince* (written in 1513 and published in 1532) praised Cesare as the model of a clever, unscrupulous ruler who would do anything to keep power.

WORLD BOOK photo by E. F. Hoppe

The border terrier is a strong hunting dog.

Cesare was born in Subiaco, near Rome, Italy, around 1475. He was the son of Rodrigo Borgia, a Spanish nobleman who later became Pope Alexander VI. After Rodrigo became pope in 1492, Cesare was made an archbishop and later a cardinal. In 1498, Cesare began a military career. He conquered several towns in central Italy and created a small state out of them. One time, when his enemies began to plot against him, he captured them by pretending to be friendly and then had them murdered. He also had his sister Lucrezia's husband killed for political reasons. Cesare's reign ended when his father died in 1503. Cesare's state collapsed, and he fled. He later became a professional soldier. Cesare died in battle in what is now Spain. Paul F. Grendler

Borgia, *BAWR juh,* **Lucrezia,** *loo KREE zhuh* (1480-1519), was an Italian noblewoman and the daughter of Pope Alexander VI. People who hated her powerful father and her cruelly ambitious brother, Cesare Borgia, told lies about Lucrezia to ruin her reputation.

Lucrezia Borgia was probably born on April 19, 1480, in Subiaco, near Rome, Italy. She was the daughter of Rodrigo Borgia, a Spanish nobleman who later became Pope Alexander VI. Her father married her off to princes for his political gain. She was first married at age 13, but that marriage was annulled when she was 17. She married again at age 18, but her older brother, Cesare, had that husband killed. Enemies of her father and brother spread the lie that she committed incest with her father and brother. In 1501, she married Alfonso d'Este, the future Duke of Ferrara. She presided over the glittering court of Ferrara, where she was a leader of fashion. She helped artists and writers and was generous to the people. In 1519, she died of an infection after the birth of her seventh child. Paul F. Grendler

Borglum, *BAWR gluhm,* **Gutzon,** *GUHT suhn* (1867-1941), was an American sculptor best known for creating the Mount Rushmore National Memorial in South Dakota. This work consists of huge portraits of four American presidents—George Washington, Thomas Jefferson, Theodore Roosevelt, and Abraham Lincoln—carved out of a mountain (see Mount Rushmore National Memorial). Borglum's works have a powerful naturalistic style. Many of them reflect his fascination with size and the beauty of animals, especially horses. They also show the influence of his early life on the American frontier.

John Gutzon de la Mothe Borglum was born of Danish parents near Bear Lake, Idaho, on March 25, 1867. He studied art in San Francisco and at the Académie Julian in Paris. He was influenced by the vigorous modeling of French sculptor Auguste Rodin. In 1901, after success as a painter in England, Borglum settled in New York City.

In 1916, Borglum was commissioned to carve a huge memorial to the Confederate Army into Stone Mountain in Georgia. Borglum designed a long procession of Confederate troops led by General Robert E. Lee. Disputes with his sponsors led to Borglum's dismissal before the project was completed. He realized his ambition of creating a gigantic sculpture from a mountain with the Mount Rushmore memorial, which he began in 1927. He worked on the project until his death. Lincoln Borglum, his son, also worked on the memorial.

Other major works by Borglum include the monumental *Wars in America* (1927) in Newark, New Jersey; *Trail Drivers Memorial* (1940) in San Antonio, Texas; and two sculptures in Washington, D.C., a giant head of Abraham Lincoln (1908) in the U.S. Capitol and a statue of General Philip Sheridan (1909). Borglum's younger brother, Solon, was also a noted sculptor. George Gurney

Borlaug, *BAWR lawg,* **Norman Ernest** (1914-), an American agricultural scientist, received the 1970 Nobel Peace Prize for developing new and higher-yielding varieties of wheat. In 1944, the Rockefeller Foundation sent Borlaug to Mexico to develop varieties that would increase wheat production in tropical regions. By the 1950's, Borlaug's wheat had greatly increased Mexican harvests. From 1960 to 1963, Borlaug served as the director of the Inter-American Food Crop Program. He was director of wheat programs for the International Maize and Wheat Improvement Center from 1964 to 1979.

In the 1960's, India, Pakistan, and other countries began to plant high-yielding varieties of wheat developed by Borlaug. These varieties changed some nations from grain importers into grain exporters and reduced the danger of famine. The improvement in the world's food supply that resulted from such new varieties of crops is sometimes called the Green Revolution. Borlaug was born in Cresco, Iowa, on March 25, 1914. Larry D. Trede

See also Wheat (picture: New varieties of wheat).

Borman, Frank (1928-), commanded the United States Apollo 8 space flight, which circled the moon in 1968. Borman made the flight with astronauts James A. Lovell, Jr., and William A. Anders.

Borman and Lovell also circled the earth for 14 days in Gemini 7 in 1965. Gemini 7 and Gemini 6 made the first *rendezvous* (meeting) in space. Borman resigned from the space program in 1970. He became president of Eastern Airlines in 1975. He became chairman of the board in 1976. Texas Air Corporation bought Eastern in 1986, and Borman served as vice chairman of Texas Air from 1986 to 1991. Since 1988, he has been president of Patlex Corporation, a company that enforces—and makes commercial use of—patents related to lasers.

Borman was born in Gary, Indiana, on March 14, 1928. In 1950, he graduated from the U.S. Military Academy and joined the Air Force. In 1957, he earned a master's degree in aeronautical engineering from the California Institute of Technology. He became an astronaut in 1962. Lillian D. Kozloski

Bormann, Martin (1900-1945?), was one of the most powerful leaders in Nazi Germany during World War II (1939-1945). He served as the top aide to Nazi dictator Adolf Hitler. Bormann supported the harshest measures against Jews, Poles, and Christian churches.

Bormann was born in Halberstadt, Germany, on June 17, 1900. In 1927, he joined the Nazi Party. In 1933, he became chief of staff under Rudolf Hess, Hitler's secretary and deputy. In 1941, after the British imprisoned Hess, Hitler chose Bormann to take on many of Hess's duties. Bormann decided who could see Hitler and issued orders in Hitler's name, often without Hitler's knowledge.

Bormann escaped capture after the war ended in 1945. The German government said he had died in Berlin, Germany. In 1945, after the war, Bormann was put on trial as a war criminal *in absentia* (while absent) at Nuremberg, Germany. He was sentenced to death in 1946. In 1998, scientists announced that genetic tests on human remains found in Berlin in 1972 identified those remains as Bormann's. William Sheridan Allen

Born, Max (1882-1970), was a German physicist who played a major role in developing *quantum mechanics.* This field of physics describes the structure of atoms and the motion of atomic particles. Born shared the 1954 Nobel Prize in physics for his work.

In 1924, Louis de Broglie, a French physicist, suggested that waves, called *matter waves,* control the motions of atomic particles. This idea led the Austrian physicist Erwin Schrödinger to develop a system of mathematical procedures and physical concepts called *wave mechanics.* Chiefly on the basis of Schrödinger's work, Born concluded that matter waves simply indicate the probable presence of particles in any given location.

Born also contributed to the fields of crystallography and optics. He received a Ph.D. degree from the University of Göttigen in 1907. He was born in Breslau, Germany (now Wrocław, Poland). Roger H. Stuewer

Borneo, *BAWR nee OH,* is the third largest island in the world. Only Greenland and New Guinea are larger. Borneo is about 400 miles (640 kilometers) east of Singapore. About one-fourth of Borneo consists of Brunei and part of Malaysia. About three-fourths of Borneo is part of the Republic of Indonesia (see **Indonesia** [map]).

The land and its resources. Borneo covers about 287,000 square miles (743,330 square kilometers). Indonesian Borneo covers about 210,000 square miles (543,900 square kilometers). Sabah (formerly North Borneo) and Sarawak cover about 75,000 square miles (194,250 square kilometers). Brunei's area is about 2,000 square miles (5,180 square kilometers). They lie along the northern and northwestern coasts of Borneo. Two connecting mountain ranges cut through Borneo. The

Brian Moser, Hutchison Library

A Dayak woman harvests rice on a Borneo hillside. Rice is the island's chief food and a major export. Most of Borneo's inhabitants are Dayaks. They live along the coast and in the mountains.

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Kapuas Range lies in the center, and the Schwaner Range in the south. Mount Kinabalu, 13,431 feet (4,094 meters) high, is the highest peak.

Swamps cover much of the coastal area. Tidal silt obstructs the entrances to many rivers and ports. Brunei Bay, on the north coast, has the best harbor. It served as an important Japanese naval base in World War II. Major rivers include the Rajang in Sarawak, the Kapuas in western Indonesian Borneo, the Barito in the south, and the Mahakam in the east. Shallow-draft vessels can navigate these rivers up to 100 miles (160 kilometers) inland. There are many waterfalls in the mountain regions. A hilly plateau circles the mountains in many areas, before dropping to the coastal lowlands.

Borneo has a tropical monsoon climate. Its rainy season lasts from November to April each year. Rainfall ranges from 100 to 210 inches (250 to 533 centimeters). Average rainfall is 120 inches (305 centimeters). The temperature ranges from 70 to 95 °F (21 to 35 °C) with an average annual temperature of 80 °F (27 °C).

Borneo has some of the world's richest deposits of petroleum. Diamonds have been discovered in many places. The Indonesians call Borneo *Kalimantan,* meaning *River of Diamonds.* However, Borneo's diamonds have a yellow tint and are not as valuable as the diamonds of Africa. Copper, gold, iron, manganese, and tin have also been found in Borneo. The thick forests contain more than 50 kinds of lumber. Teakwood is the

most valuable forest product from Borneo. Benzoin, camphor, rattan, and *cutch,* a gumlike mangrove-bark product used in tanning, are also gathered in Borneo.

The west coast of the island produces about 8 percent of Indonesia's rubber exports. Other exports include cinnamon, cloves, coffee, cotton, nutmeg, pepper, rice, sugar, and tobacco.

Rice, the chief food in Borneo, is cultivated almost everywhere on the island. Fruits, sago, sugar cane, and yams also are grown for local consumption.

The people and their work. Borneo has about 12 million people. About 73 percent of the people live in Indonesian Borneo. The Malaysian areas have about 25 percent, and Brunei has about 2 percent. Most of Borneo's inhabitants are Dayaks. They live along the coast and in the mountains of Borneo. The coastal Dayaks have mixed heavily with Chinese and other Asian peoples. Most Dayaks follow traditional local religions. Some Dayaks have preserved ancient handicraft skills and carve beautiful articles out of wood. See **Dayaks.**

Most of the people of Indonesian Borneo are Muslims. Large numbers of Chinese live in such cities as Banjarmasin, Kuching, and Pontianak. Some Europeans live in Brunei, Sarawak, and Sabah.

Industries in Borneo center chiefly around the production and export of oil and rubber. The largest oil installations are at Balikpapan and Tarakan on the east coast. Borneo produces chicle, a gummy substance used in making chewing gum. The women of Borneo weave cotton cloth and beautiful mats.

Transportation. Borneo has about 110 miles (177 kilometers) of railroads and less than 2,500 miles (4,020 kilometers) of highways. Rivers provide transport for most goods. The people use water buffaloes as beasts of burden and for transportation.

Government. Indonesian Borneo is divided into four provinces—West, South, Central, and East Kalimantan. Governors appointed by the Indonesian Cabinet head the provinces. There is a 40- to 60-member council in each province, appointed by the government. Sabah and Sarawak are part of Malaysia. Brunei is an independent country headed by a sultan.

History. The west coast of Borneo was dotted by Asian trading stations long before the first Europeans arrived in Asia. The Sultanate of Brunei dates from the 1200's. Remains of Hindu-Javanese settlements in the 1300's can still be seen in Borneo. European explorers first reached Borneo in the early 1500's. Dutch, Portuguese, and Spanish traders arrived on the island around 1600.

In the 1800's, the Netherlands took over most of Borneo, often by force. British interests gained control of the northwestern area in the mid-1800's. In 1841, the sultan of Brunei ceded the southern part of his territories, called *Sarawak,* to an Englishman, James Brooke. He had helped the sultan quiet a local rebellion. In 1846, the British government annexed the island of Labuan. The British declared North Borneo, Sarawak, and Brunei protectorates in 1888. Residents raised few objections to the British administration. Brooke and his descendants, called *white rajahs,* ruled Sarawak as a self-governing, British-protected state until after World War II. In 1891, the Dutch and British governments officially set up the boundaries of the territories in Borneo.

During World War II (1939-1945), the Japanese occupied most coastal sections of the island. In 1946, North Borneo and Sarawak became British crown colonies. Brunei retained its status as a protectorate. Between 1946 and 1949, Indonesian Borneo was divided into self-governing units, sponsored by the Dutch. Dutch control ended in 1949, when Indonesian Borneo became part of the Republic of Indonesia. In 1963, Sabah (North Borneo) and Sarawak joined Malaysia. Brunei remained under British protection until 1984, when it became an independent nation. Colin MacAndrews

See also **Banjarmasin; Brunei; Indonesia; Malaysia.**

Borodin, *BAWR uh deen,* **Alexander** (1833-1887), was a Russian composer. His music is distinguished by lyric melody, vigorous rhythm, and imaginative orchestration. Some works have a colorful Asian sound.

Borodin's largest and most important work is the opera *Prince Igor,* first performed in 1890. It was unfinished when Borodin died and was completed by Nikolai Rimsky-Korsakov and Alexander Glazunov. Its ballet music, the "Polovtsian Dances," is an outstanding example of Borodin's Asian style. In his skillfully orchestrated tone poem *In the Steppes of Central Asia* (1880), Borodin alternated and combined Russian and Asian themes. Of his three symphonies, the second (1877) is viewed as one of the most original symphonies ever written by a Russian composer.

Borodin was born in St. Petersburg. He studied chemistry and other sciences there and received a doctorate in chemistry in 1858. Borodin wrote music while he taught chemistry and conducted scientific research.
Edward V. Williams

Boron, *BAWR ahn,* is an extremely hard, nonmetallic element. It is quite evenly distributed in small amounts throughout the earth's surface. The chief sources of boron and boron compounds are mineral deposits that result from the evaporation of lakes and other bodies of water. Major deposits of boron minerals are found in Kazakhstan, Turkey, the United States, and a strip of South America from Peru to Argentina.

Boron is essential to proper plant growth. It also has many industrial uses. Adding boron to steel increases its hardness and its strength at high temperatures. An isotope of boron called *boron-10* is used in nuclear reactors because of its ability to absorb neutrons. Compounds of boron and oxygen, such as borax and boric acid, are used in heat-resistant glass, detergents and soaps, enamels, and medicines. A compound of boron and nitrogen, called boron nitride or Borazon, is one of the hardest materials known and is used as an abrasive.

Boron ranges from brown to black. It has the chemical symbol B. Its atomic number is 5, and its atomic weight is 10.811. In its most stable form, it has a melting point of 2180 °C and a boiling point of 3650 °C. At 20 °C, it has a density of 2.34 grams per cubic centimeter (see **Density**). Boron was first isolated and identified as an element in 1808 by the French scientists Joseph Louis Gay-Lussac and Louis Jacques Thenard. Clark L. Fields

See also **Borax; Borazon; Mojave Desert.**

Borough, *BUR oh,* is a unit of local government. In several Eastern states of the United States, the word *borough* means simply an incorporated town. Alaska is divided into boroughs that are similar to counties but have greater control of their own affairs.

In the United Kingdom, a borough is a district that elects a member to Parliament. In early England, a borough was a walled town or fortified place. A *rotten borough* was a borough that had lost much of its population but still had representation in Parliament. A *pocket borough* was a borough controlled by a powerful or wealthy person. Susan H. Ambler

See also **New York City** (The city).

Borromini, *BAWR uh MEE nee,* **Francesco,** *fran CHEHS koh* (1599-1667), was a major Italian architect during the baroque period of the 1600's. Baroque architecture is dominated by the rise of complex and sculptural curved lines. Borromini is noted for the imagination and originality with which he emphasized the use of space and mass in his buildings. His work greatly influenced later baroque architects of northern Europe.

Borromini was born Sept. 25, 1599, in Bissone, in what is now Switzerland. He went to Rome about 1619. There he worked as an assistant to Gian Lorenzo Bernini on the construction of the great *baldacchino* (canopy) over the main altar in St. Peter's Basilica. Borromini's first project as an architect was the small church of San Carlo alle Quattro Fontane (begun in 1638). His most significant work is considered to be the church of Sant' Ivo della Sapienza (1660). From 1653 to 1657, Borromini worked on the church of Sant' Agnese in Agone. J. William Rudd

See also **Architecture** (Baroque architecture); **Italy** (Arts [picture]).

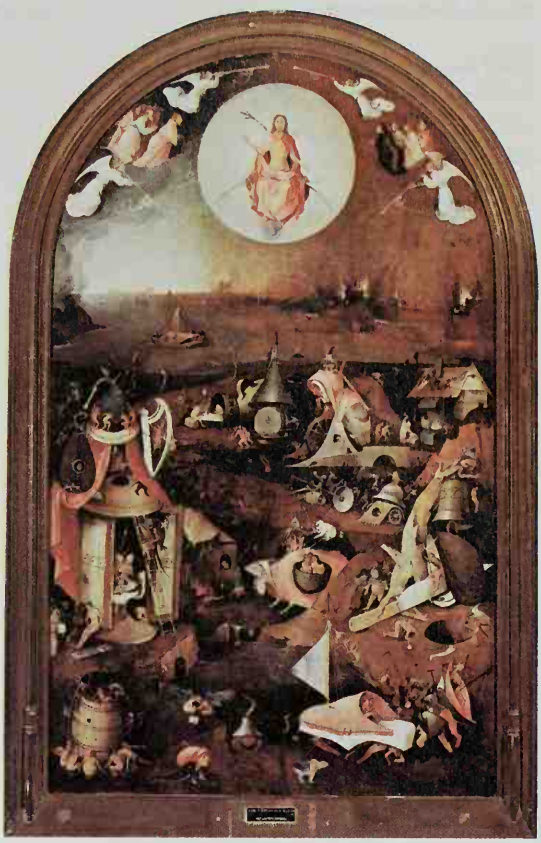
Borzoi, *BAWR zoy,* also called *Russian wolfhound,* is a dog originally bred in Russia to chase down game animals. The word *borzoi* is Russian for *swift.* The borzoi is a tall, lean, elegant dog from 26 to 31 inches (66 to 79 centimeters) high. Males weigh from 75 to 105 pounds (34 to 48 kilograms), with females weighing less. Most borzois are white or dark with patches of gray, brown, or black. See also **Dog** (picture: Hounds); **Wolfhound.**

Critically reviewed by the Borzoi Club of America

Bosch, *bahsh* or *bahs,* **Hieronymus,** *HEE uh ROH nuh muhs* (1450?-1516), was a Dutch painter. He is best known for his imaginative *triptychs* (three-paneled paintings). Many of his paintings show landscapes full of malformed people, fantastic demons, distorted animals, large and oddly shaped pieces of food, and sometimes unidentifiable objects. His works reflect the influence of Dutch proverbs and puns, popular literature, Biblical parables, witchcraft, alchemy, and astrology.

Bosch's paintings reveal his obsession with the Devil and the Devil's followers. Much of the imagery shows that humanity was doomed to suffer tortures in hell because of the foolish, greedy, and lustful nature of human beings. Bosch's paintings typically consist of many separate episodes. For example, in the triptych *The Temptation of Saint Anthony* (about 1500), the saint is in the midst of a vast, decaying landscape overrun with monstrous demons. The demons offer Anthony various worldly pleasures to tempt him from his holy life.

Bosch's largest and most complex work is a triptych called *The Garden of Earthly Delights* (about 1500). Like other Bosch works, this painting has been interpreted in many ways. One interpretation sees the work as an attack on human folly. However, other interpreters have suggested that the painting demonstrates how human beings can return to the natural state of innocence that existed before the fall of Adam and Eve. Bosch took his name from Hertogenbosch, his birthplace in the Netherlands. Linda Stone-Ferrier



The Last Judgment (early 1500's), the center panel of a three-part oil painting on wood; Groeninge Museum, Bruges, Belgium

A typical Bosch painting is filled with fantastic creatures, demons, and objects. The artist painted these forms in a colorful, detailed style against a realistic landscape background.

Bosnia-Herzegovina, *BAHZ nee uh* or *BAWS nee uh, HURT suh goh VEE nuh* or *HEHRT seh goh VEE nuh,* is a country in southeastern Europe. It is often simply called Bosnia. Sarajevo is the capital and largest city.

Slavic peoples make up most of Bosnia-Herzegovina's population. The largest groups are the Bosnian Muslims, the Serbs, and the Croats. Conflicts among these groups have shaped the history of the region.

In 1918, Bosnia-Herzegovina became part of the Kingdom of the Serbs, Croats, and Slovenes, later renamed Yugoslavia. In 1946, Yugoslavia became a federal state consisting of six republics, one of which was Bosnia-Herzegovina. From 1945 to 1990, Communists controlled Yugoslavia. In 1990, Bosnia held its first free elections, and non-Communists won control of the legislature.

In March 1992, Bosnia declared its independence from Yugoslavia. Much of Bosnia's Serbian population opposed independence, and war broke out. In December 1995, representatives of the opposing sides in the conflict signed a peace plan.

Government. Under the terms of the peace plan of 1995, Bosnia-Herzegovina is divided into two parts. The

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Facts in brief

Capital: Sarajevo.
Principal language: Serbo-Croatian.
Area: 19,741 mi² (51,129 km²). *Greatest distances*—north-south, 195 mi (315 km); *east-west,* 195 mi (315 km).
Elevation: *Highest*—Mount Maglić, 7,828 ft (2,386 m) above sea level. *Lowest*—sea level along coast.
Population: *Estimated 2002 population*—3,890,000; density, 197 per mi² (75 per km²); distribution, 60 percent rural, 40 percent urban. *1991 census*—4,377,033.
Chief products: *Agriculture*—cattle, cherries, corn, grapes, hogs, peaches, pears, plums, potatoes, sheep, soybeans, tobacco, walnuts, wheat. *Manufacturing*—electric appliances, textiles. *Mining*—coal, iron ore.
Flag: Two unequal vertical stripes of blue separated by a yellow triangle. Nine white stars run along the border of one of the blue sections. See **Flag** (picture: Flags of Europe).
Money: *Basic unit*—marka.

plan awarded control of 51 percent of the country to a Muslim-Croat federation and 49 percent to Bosnian Serbs. Each part has its own president and legislature.

The national government consists of a three-member presidency, a council of ministers, and a legislature with two houses. But in practice, the two regional governments hold the real power.

People. Bosnian Muslims make up the largest ethnic group. Serbs make up the second largest group, and Croats the third largest. Bosnia also has small numbers of Albanians, Gypsies, and Ukrainians.

Most of the people of Bosnia speak a language called Serbo-Croatian. In writing, Serbs traditionally employ the Cyrillic alphabet, the system that is used in writing Russian. But Bosnian Muslims, Croats, and others use the Roman alphabet.

About a third of Bosnia's people live in cities. The rest of the population lives in small rural villages.

Bosnian cooking reflects Turkish and Muslim influences. Popular dishes include *musaka* (roasted meat and eggplant) and *kapama* (mutton with spinach and green onions). Mostar produces an excellent white wine.

Children in Bosnia-Herzegovina must attend eight years of elementary school. There are universities in Banja Luka, Mostar, Sarajevo, and Tuzla.

Bosnian Muslims have traditionally practiced the Islamic faith. The religious heritage of most Serbs is Serbian Orthodoxy, and that of most Croats is Roman Catholicism. For Catholic Croats, traditional Catholic observances and pilgrimages are important.

Land and climate. Bosnia-Herzegovina consists of two land regions. Bosnia, the northern part, is a mountainous land covered with thick forests. Herzegovina, the southern part, is composed largely of rocky hills and flat farmland. The country's major rivers include the Bosna, Drina, Neretva, and Vrbas.

Bosnia-Herzegovina has cold, snowy winters. Heavy rains fall in early summer. Summers are warm in the mountain valleys but cool at higher elevations. Far northern Bosnia has cold winters and dry, hot summers. The average January temperature in Sarajevo is 30 °F (−1 °C). The average July temperature is 68 °F (20 °C).

Economy. War in the 1990's shattered Bosnia's economy. The Muslim areas of the country were especially hard hit. Industrial production in Bosnia is only a fraction of what it was before the war, and unemployment remains high. Other countries pledged billions of dollars to help rebuild Bosnia. Reconstruction and repair projects include roads, railroads, bridges, and schools.

History. A people called the Illyrians lived in what is now Bosnia-Herzegovina beginning about 3,000 years ago. The region became part of a Roman province in about 11 B.C. Slavs settled in the region in the late A.D. 500's and 600's. From the 900's to the 1100's, rule shifted between the Byzantine Empire, Croatia, and Serbia. Hungary's king claimed control over most of Bosnia from the 1100's to the 1400's, but local nobles, called *bans,* were able to act independently much of the time. Hum (now Herzegovina) was under Serbian or Hungarian rule from the 1100's until 1326. Bosnia controlled it from 1326 until 1448, when its local ruler declared his independence and adopted the title *herzeg,* which means *duke.*

The Ottoman Empire gained control of most of Bosnia in 1463 and seized Herzegovina in the 1480's. In the centuries following the invasion, some Slavs in the region converted to Islam. The Ottomans made Bosnia and Herzegovina one political unit in the mid-1800's. After Russia defeated the Ottoman Empire, the Congress of Berlin met in 1878 to decide the future of the Balkans. (See **Berlin, Congress of.**) It gave temporary control of Bosnia-Herzegovina to Austria-Hungary, which formally took power in 1908.

© Ron Sanford, Black Star

Bosnia-Herzegovina has many small rural villages. This scenic village is set amid rolling hills and thick forests. About two-thirds of the people of Bosnia-Herzegovina live in rural areas.

In June 1914, Archduke Franz Ferdinand of Austria-Hungary was assassinated in Sarajevo by Gavrilo Princip, a Serbian from Bosnia-Herzegovina. The assassination led to the outbreak of World War I. After the war ended in 1918, Bosnia-Herzegovina became part of the new Kingdom of the Serbs, Croats, and Slovenes. The kingdom was renamed Yugoslavia in 1929.

Communist rule. During World War II (1939-1945), the Axis powers led by Germany and Italy occupied Yugoslavia. Croatia briefly became a supposedly independent state, but it was actually controlled by Germany. Bosnia-Herzegovina was placed under Croatia's control. After the war ended, Communists came to power in Yugoslavia. Under a constitution passed in 1946, Yugoslavia was organized as a federal state—that is, one in which the powers of government were shared between a central government and republics. Bosnia-Herzegovina became one of the six republics of Yugoslavia, as did Croatia.

During the period when Communists ruled Yugoslavia, the republic of Bosnia-Herzegovina was sometimes classified as a less-developed region. This classification enabled it to receive federal funds for economic development. But some regions remained very poor.

Bosnia-Herzegovina has long been a site of conflict because of the cultural and religious differences between its ethnic groups. In the late 1980's, relations between the groups steadily worsened, especially between Serbs and non-Serbs.

In 1990, the Communist Party gave up its monopoly on power in Yugoslavia, and political parties began to form. That year, Bosnia held free elections for the first time. Non-Communists won control of the legislature.

Independence and war. In June 1991, Yugoslavia began to break apart after Croatia and Slovenia declared their independence. In February and March 1992, a referendum on independence was held in Bosnia-Herzegovina. Most Serbs boycotted the referendum, but a majority of the population voted for independence. Bosnia-Herzegovina then declared its independence.

Many Serbs living in Bosnia-Herzegovina opposed the declaration of independence and began a war against non-Serbs. They were aided by the Yugoslav army, which was controlled by Serbs. About two-thirds of Bosnia fell to Serbian forces within two months. The Serbs sought to remove all non-Serbs from the territory they claimed, killing some and forcing others to move. This policy was called *ethnic cleansing.*

In April 1992, Serbia and Montenegro formed a smaller Yugoslavia. The new Yugoslavia provided troops and equipment to Serbs fighting in Bosnia-Herzegovina. In May, the United Nations imposed an oil and trade embargo against Yugoslavia in an attempt to end the war.

Troops fighting against the Serbs in Bosnia included Bosnian Muslims and Bosnian Croats. As the war continued, Bosnian Croatian forces, supported by Croatia, gained control of about one-fifth of the country. In July 1992, some Bosnian Croats began to call for independence for the Croatian areas.

In mid-1992, reports began coming out of Bosnia that Bosnian Serbs had tortured and killed Bosnian Muslim and Croatian civilians being held in detention camps. In October, the United Nations established a war-crimes commission to investigate these charges and other reported incidents of human-rights abuses.

Also in October, fighting broke out between Bosnian Croats and Bosnian Muslims. The fighting increased in 1993. But in February 1994, the two sides signed a cease-fire agreement. In March, they agreed to form a joint federation. The Bosnian Serbs continued fighting, however, and they refused to consider an international peace plan that was proposed in mid-1994.

The Dayton peace plan. In late 1995, representatives of Bosnia, Croatia, and Serbia agreed to meet for peace negotiations. The negotiations took place in the United States, in Dayton, Ohio. The peace plan that was signed in December called for dividing Bosnia into two parts. A Muslim-Croat federation would have control of 51 percent of the country, and Bosnian Serbs would control the other 49 percent.

The Dayton peace plan called for free elections, which were held in September 1996. Bosnian voters elected a three-member national presidency and also elected members of a national legislature. In addition, the Muslim-Croat federation and the Bosnian Serb republic each elected a regional presidency and a regional legislature. Nationalist parties, which opposed a unified Bosnia, won the elections. Observers charged that the elections had been marred by irregularities in voter registration and interference with the campaigns of opposition parties.

The Dayton peace plan called for an end to acts of terrorism and violence, the surrender of war criminals to

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Bosnia's capital, Sarajevo, has an old section called Bascarsija, *shown here,* which reflects the city's Ottoman heritage. Bosnia was part of the Ottoman Empire from the mid-1400's to 1878.

international authorities, guarantees that refugees could return to their homes, and free movement throughout Bosnia. The plan also called for a cease-fire policed by troops of the North Atlantic Treaty Organization (NATO).

But Bosnia's ethnic groups remained divided, and hostilities continued. Movement throughout the country continued to be restricted. Many refugees were unable to return to their homes or afraid to do so. A number of war criminals were tried and convicted by an international court established by the United Nations Security Council, but other war criminals remained at large.

Recent developments. Bosnia-Herzegovina struggled to repair the damage done by the war. The country's poor economy led to problems with unemployment and organized crime. Ethnic strife and mistrust remained widespread.

In elections in 2000, the nationalist parties lost their majority in the federal parliament. By early 2001, multiethnic and reformist parties assembled a coalition to rule the country. Some Bosnian Croats and Serbs still hoped to create their own states within Bosnia, in violation of the Dayton peace plan. Sabrina P. Ramet

See also **Clinton, Bill** (International affairs); **Sarajevo; Yugoslavia.**

Boson, *BOH sahn,* is any member of a certain class of atomic and subatomic particles. Every particle is either a boson or a *fermion.* Bosons include *photons,* the particles of light.

The simplest bosons are the *fundamental,* or *gauge, bosons.* These are *elementary particles*—that is, they have no known smaller parts. Fundamental bosons transmit the fundamental forces between other particles. One particle gives off a boson, and the other absorbs it.

There are three known types of fundamental bosons: (1) photons, (2) gluons, and (3) weak bosons. Photons transmit electromagnetic forces. Photons whose energy falls within a certain range are the particles of light. Gluons transmit the *strong nuclear force,* or *strong interaction,* which holds the particles in nuclei together. There are eight kinds of gluons. Weak bosons transmit the *weak nuclear force,* or *weak interaction,* which is responsible for several forms of radioactivity. Weak bosons also play a major role in the nuclear reactions that power the sun and other stars. There are three kinds of weak bosons—two W bosons and the Z boson.

Commonly accepted theories of matter include two kinds of fundamental bosons yet to be discovered. The *graviton* transmits gravitational force. The *Higgs boson* is the source of the mass that most particles carry.

Bosons also include *composite objects* made up of an even number of fermions. The composite object can be a nucleus, an atom, or a molecule.

Bosons differ from fermions in *spin,* a measure of internal rotation. Bosons have whole-integer values of spin (0, 1, 2, and so forth). Fermions have half-number values ($\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$, and so forth).

Bosons were named for the Indian physicist Satyendra Nath Bose, who first proposed a theory of their behavior in the 1920's. The work of German-born physicist Albert Einstein completed the theory. Robert H. March

See also **Higgs boson.**

Bosporus, *BAHS puhr uhs,* is a strait in northwestern Turkey that connects the Black Sea and the Sea of Marmara. It is part of a waterway that flows from the Black Sea to the Mediterranean Sea. The Bosporus, also spelled *Bosphorus,* is 19 miles (31 kilometers) long. Istanbul lies on the strait.

The Bosporus has great commercial importance. The strait is an important outlet for ships of nations that border the Black Sea. At the Straits Convention in 1841, it was agreed that no war vessels could pass through the Bosporus and Dardanelles straits without the consent of the Ottoman Empire (which later became Turkey). In 1923, the Treaty of Lausanne opened the straits to ships of all countries. In the Montreux Convention of 1936, Turkey regained control of the waterway.

WORLD BOOK map

Location of the Bosporus

The Bosporus gets its name from Greek words meaning *ox ford,* probably because it was so narrow in some places that cattle could cross. According to a Greek myth, the beautiful maiden Io swam the Bosporus in the form of a white cow. Darius I, a Persian king, built a famous bridge of boats across the Bosporus on his expedition into Thrace about 513 B.C.

A bridge across the Bosporus—the first since the bridge of boats built by Darius I—was finished in 1973. Called the Bosporus Bridge, it links the Asiatic and European sections of Istanbul. A second bridge, called the Fatih Sultan Mehmet Bridge, was completed in 1988 and also connects the two parts of Istanbul. F. Muge Gocek

See also **Dardanelles; Istanbul; Marmara, Sea of.**

Boston

© Steve Dunwell

Boston's Copley Square blends the modern with the historic. The soaring John Hancock Tower overlooks Trinity Church, which was designed in the 1870's.

Boston is the capital of Massachusetts and the largest city in New England. It is also New England's leading business, financial, government, and transportation center. Boston lies along the Atlantic coast in eastern Massachusetts. Its sheltered harbor helps make the city a busy seaport. In addition to its commercial importance, the Boston area is a center of education, medicine, and technology. Its many outstanding universities, libraries, and other centers of learning have earned it the nicknames the *Hub of the Universe* and the *Athens of America.*

Boston is one of the oldest and most historic cities in the United States. English Puritans founded it in 1630. They named it after the town of Boston, England, where many of them had lived. Boston grew rapidly in size and wealth during the 1600's and 1700's because it served as the American Colonies' chief seaport for ships bound for England and the West Indies. Elegant houses and stately churches that date from the 1700's still stand along Boston's narrow, winding streets.

Boston is known as the *Cradle of Liberty* because it was the birthplace of the Revolutionary War in America (1775-1783). The Boston Massacre, the Boston Tea Party, and several major battles of the Revolutionary War occurred in or near the city. Every year, large numbers of tourists come to Boston to see Paul Revere's house, the Bunker Hill Monument, Faneuil Hall, the Old State House, and other reminders of the revolutionary period.

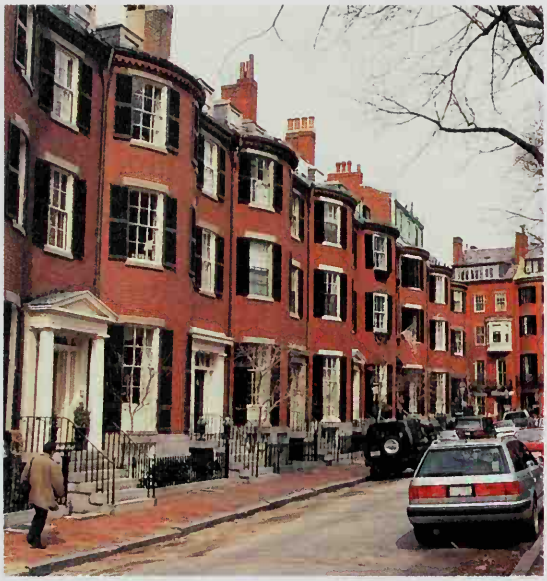
After the Revolutionary War and through the 1800's, Boston continued to be a leading port. Also, the city's industries grew rapidly and made it an important manufacturing center. The city also began to receive many immigrants. In the mid-1800's, for example, hundreds of thousands of Irish people poured into Boston to escape starvation in Ireland, where the potato crop had failed.

In the last half of the 1900's, Boston experienced many of the same problems faced by most other major United States cities. These problems included poverty, racial unrest, declining neighborhoods, and a loss of families and businesses to the suburbs. To ease some of its problems, the city undertook a huge urban renewal program in the early 1970's. The construction of modern apartments, offices, and stores and gradual improvement in the city's public schools helped attract families and businesses back to the city. In the late 1900's and early 2000's, the downtown area became the focus of a number of development projects.

The city

Boston covers 51 square miles (134 square kilometers). The Neponset River borders the city on the southeast. The Charles, Chelsea, and Mystic rivers separate Boston from several suburbs to the north and west.

Since its founding in 1630, Boston has grown to about 40 times its original size. The English founded the city on a 783-acre (317-hectare) peninsula between the Charles River and Boston Harbor. The Indians who lived in the region called the peninsula *Shawmut.* In the mid-1800's, the city added 3,000 acres (1,200 hectares) of land to the Shawmut peninsula by filling in some of the shallow



© Paula Lerner, Woodfin Camp, Inc.

Beacon Hill, with its elegant red-brick houses, has been a fashionable neighborhood since the late 1700's.

coastal waters. Over the years, Boston also expanded by annexing many nearby towns. Most of the city's neighborhoods, such as Charlestown, Dorchester, Roxbury, and South Boston, were once independent.

Boston has many neighborhoods. They include Downtown Boston, Back Bay, Beacon Hill, the North End, South Boston, East Boston, Charlestown, Brighton-Allston, Roxbury, Dorchester, the South End, Mattapan, Jamaica Plain, Hyde Park, and West Roxbury.

Downtown Boston occupies the center of the Shawmut peninsula. It is a blend of historic landmarks, old factories and office buildings, and glass-and-steel skyscrapers. The area's parks, stores, historic sites, and other attractions draw millions of visitors yearly.

At the north end of the downtown area stands Government Center, a 60-acre (24-hectare) complex of offices, shops, and plazas. The center includes City Hall, which was completed in 1969, and the twin towers of the John F. Kennedy Federal Office Building. East of City Hall is historic Faneuil Hall and the Faneuil Hall Marketplace. Bostonians met in Faneuil Hall before the Revolutionary War to protest British tax and trade policies. The marketplace was developed in the 1970's from the old Quincy Market, South Market, and North Market. It includes numerous shops, food stalls, and restaurants. Boston's financial district lies south of Government Center along Congress, Federal, and Devonshire streets. A few blocks west, shoppers crowd Filene's and other department stores on Washington Street.

Boston's famous Freedom Trail begins in the downtown area and extends into the North End. The trail, a 3-mile (4.8-kilometer) marked path, passes many of the city's historic landmarks. Stops on the Freedom Trail include the site of the Boston Massacre, in which British troops fired on civilians, and the Old South Meeting House, where colonists met before the Boston Tea Party, a protest against a British tax on tea. Many of these

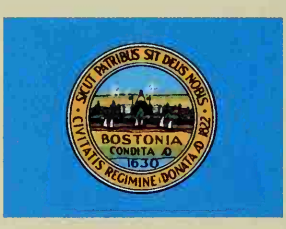
Facts in brief

Population: *City*—589,141. *Metropolitan area*—3,406,829. *Consolidated metropolitan area*—5,819,100 (5,029,148 in Mass., 739,699 in N.H., 41,375 in Me., 8,878 in Conn.).
Area: *City*—51 mi² (134 km²). *Metropolitan area*—2,019 mi² (5,229 km²). *Consolidated metropolitan area*—5,625 mi² (14,569 km²), excluding inland water.
Climate: *Average temperature*—January, 28 °F (−2 °C); July, 72 °F (22 °C). *Average annual precipitation* (rainfall, melted snow, and other forms of moisture)—44 in (112 cm). For the monthly weather in Boston, see **Massachusetts** (Climate).
Government: Mayor-council. *Terms*—4 years for the mayor; 2 years for the 13 council members.
Founded: 1630. Incorporated as a city in 1822.

Largest communities in the Boston area

Name	Population	Name	Population
Boston	589,141	Somerville	77,478
Cambridge	101,355	Framingham	66,910
Lynn	89,050	Waltham	59,226
Quincy	88,025	Brookline	57,107
Newton	83,829	Malden	56,340

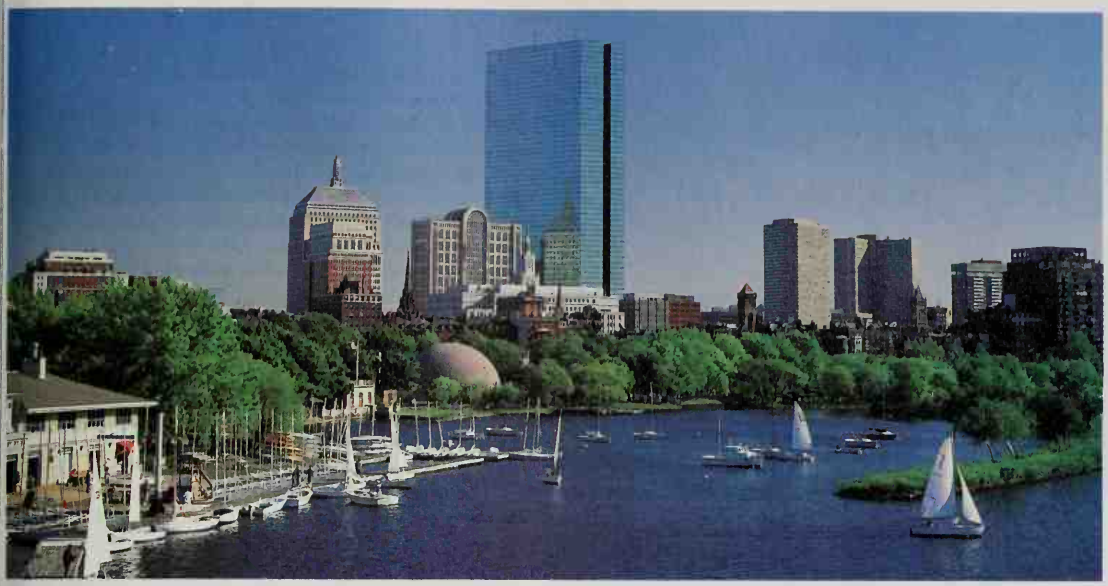
Source: 2000 census.



Symbols of Boston. Boston's flag was adopted in 1917. It shows the skyline of downtown Boston as it looked in 1822, the year Boston was incorporated as a city. The city seal dates from 1827. Boston's motto, *God Be with Us, as He Was with Our Fathers,* appears in Latin at the top of the seal.

WORLD BOOK map

Boston, Massachusetts, lies on the Atlantic coast.



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The Back Bay area, once a marshy section of the Charles River, was created on landfill in the mid-1800's. The John Hancock Tower, Boston's tallest building, rises in the background.

landmarks and others from the revolutionary era are part of the Boston National Historical Park.

Boston Common, the nation's oldest public park, covers 45 acres (18 hectares) along the western edge of downtown. John Winthrop, the leader of Boston's founders, set aside the land in 1634 as a military training field and as a public cattle pasture. Women found guilty of witchcraft in the late 1600's were hanged in the Common. The American statesman and inventor Benjamin Franklin grazed his family's cow there during his boyhood. Today, the park is a favorite meeting place for open-air political rallies. Just west of the Common lies Boston's formal Public Garden. During the spring and summer, many people like riding in the graceful swan-shaped paddleboats on the Public Garden's lake.

Back Bay stretches from the Public Garden west to the suburb of Brookline. The Back Bay area was a marshy section of the Charles River until the city's landfill project created the community in the mid-1800's. Today, long rows of beautiful old *townhouses* (houses that share a common wall) stand along the neighborhood's treelined streets. Many of Boston's most expensive stores and finest restaurants are on fashionable Boylston and Newbury streets in Back Bay.

Wealthy families lived in the Back Bay area until the 1920's, when they began to move to Boston's northern and western suburbs. Many of the townhouses were then converted into apartments. Today, Back Bay is a popular neighborhood among college students, young unmarried workers, and some families.

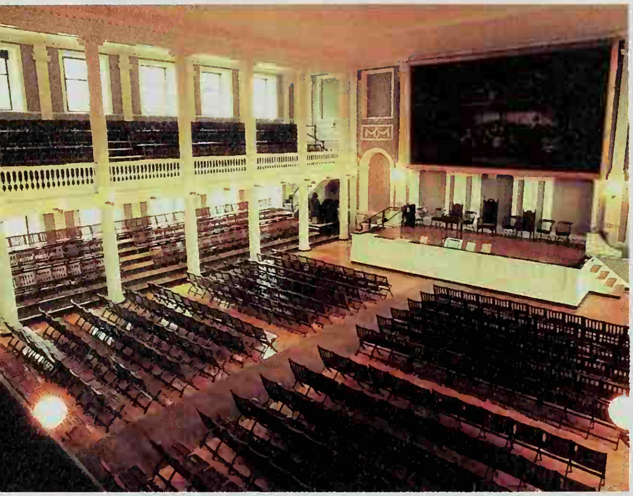
Two high-rise complexes stand out against the Back Bay skyline. Prudential Center on Boylston Street includes apartment buildings, a hotel, a civic auditorium, over 50 shops, and the 52-story Prudential Tower office building. A few blocks northeast of Prudential Center lies Copley Square. In the square stand the main branch of the Boston Public Library and the 60-story John Hancock Tower. The Hancock building ranks as the tallest skyscraper in New England. A public observation deck on the 60th floor offers visitors a fine view of Boston. Massive Trinity Church also stands in Copley Square. The church was designed by the American architect Henry Hobson Richardson in the 1870's. It is considered a national landmark.

Beacon Hill rises north of Boston Common. During the 1600's, the hill served as a beacon station for signaling ships. Since the late 1700's, Beacon Hill has been a fashionable neighborhood with gaslights and narrow, cobblestone streets.

Some of Boston's oldest and most distinguished families live in the Beacon Hill neighborhood. Elegant red-brick townhouses surround a lovely park in a charming section called Louisburg Square. The State House, the gold-domed meeting place of the Massachusetts legislature, stands atop the hill on the southern edge of the neighborhood. Brick apartment buildings line the northern slope of the hill.

The North End stretches along the east coast of the Shawmut peninsula. Several landmarks on the Freedom Trail, including the Old North Church, where lanterns were hung to warn of a British attack, and the house of the revolutionary leader Paul Revere, are in this area. In colonial times, ships from Europe and Asia docked at the North End. Today, warehouses and other buildings on the wharves are being remodeled into luxurious apartments.

Most people in the North End live in four-story brick apartment buildings along narrow, winding streets. Most of the community's residents are of Italian ancestry. Many are Roman Catholics who follow some of the traditions of their ancestors. For example, many Catholic churches celebrate religious holidays with a colorful procession and festival. Money donated to the church is pinned to the garments that clothe a large statue of Je-



© Richard Pasley, Stock, Boston

Historic Faneuil Hall, like Boston itself, is called the *Cradle of Liberty.* Bostonians held meetings in the hall before the Revolutionary War to protest British tax and trade policies.

sus Christ or a saint. Several men then carry the statue through the streets, followed by marching bands and worshipers. The festival held after the procession may include carnival rides and folk dancing.

South Boston is a large peninsula in Boston Harbor southeast of the Shawmut peninsula. Many of its residents are people of Irish descent. They feel strong ties to their families and neighborhood and take great pride in their nationality. They affectionately refer to their community as "Southie."

Until the 1940's, South Boston was one of the city's industrial, shipping, and railroad centers. But many factories closed or moved to the suburbs. As a result, unemployment rose and poverty spread. In the 1980's, however, waterfront redevelopment brought new growth. A container shipping terminal opened in 1984, and the renovation of an old pier into the World Trade Center was completed in 1986.

East Boston, another large peninsula in Boston Harbor, is the city's northeasternmost section. It is an area of wooden row houses and three-story apartment buildings. Logan International Airport lies on the peninsula's east side.

WORLD BOOK maps

Boston's Freedom Trail

The Freedom Trail is a marked path that leads to Boston's most famous historic landmarks. The 3-mile (4.8-kilometer) trail winds through the downtown and North End sections of the city.

Faneuil Hall

Faneuil Hall was the scene of many protests by angry colonists before the revolution.

Boston Massacre site. British soldiers fired into a mob of colonists and killed five patriots here in 1770.

Old State House, built in 1713, served as the seat of the colonial government.

Old State House

Site of Benjamin Franklin's birth, on Milk Street, is marked by a bronze plaque.

Old South Meeting House. Anti-British speeches here inspired the Boston Tea Party.

Old Corner Book Store was a favorite meeting place of Boston writers in the 1800's.

Site of America's first public school. The Boston Latin School, which opened in 1635, stood on this spot until 1922.

Old South Meeting House

Statue of Benjamin Franklin by Richard Greenough stands near the old City Hall.

Old Corner Book Store

Old Granary Burying Ground has the graves of Samuel Adams and Paul Revere.

Park Street Church dates from 1809. Gunpowder was stored here by U.S. military forces during the War of 1812.

State House, the capitol of Massachusetts, has many historic American documents.

King's Chapel, completed in 1754, became the nation's first Unitarian church.

Paul Revere's house, built about 1670, is the oldest house in Boston. Revere lived there at the time of his famous midnight ride.

Paul Revere's Mall, a park, has bronze tablets that describe Boston's history to 1918.

Old North Church. Lanterns hung here warned patriots of an attack by the British.

Copp's Hill Burying Ground, on Snow Street, has graves that date from 1660.

Old North Church

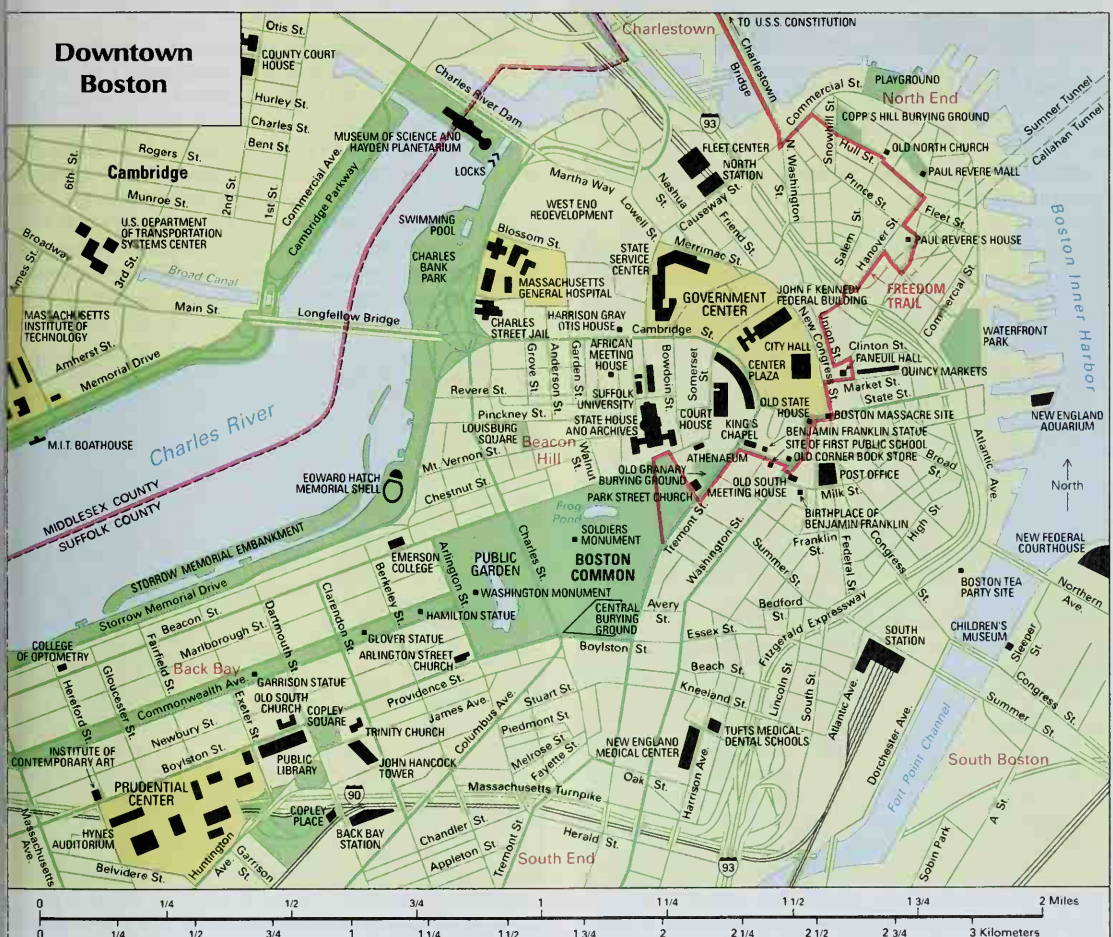
Paul Revere's House

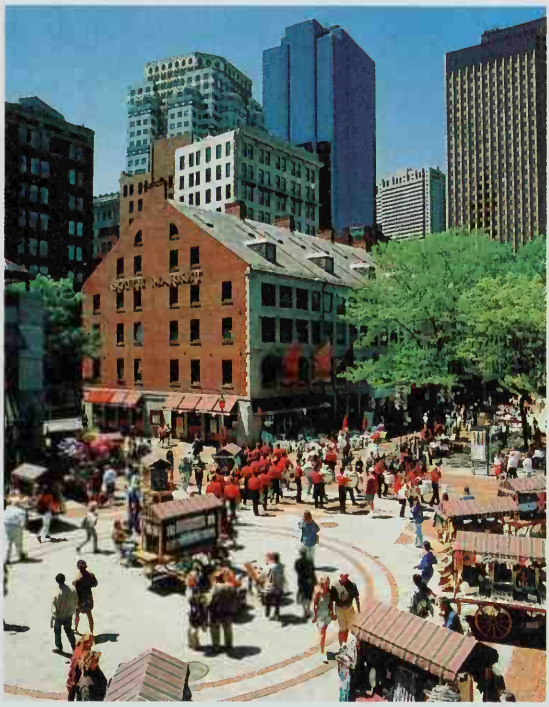
Pork Street Church

State House

King's Chapel

WORLD BOOK illustrations by David Cunningham





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Faneuil Hall Marketplace was developed from the old Quincy, North, and South markets. This lively center in downtown Boston includes food stalls, shops, and restaurants.

Charlestown is a hilly, residential section separated from East Boston by Boston Inner Harbor. English colonists founded the town of Charlestown in 1630. Many of these colonists moved on to found Boston several months later. Charlestown became part of Boston in 1873. The U.S.S. *Constitution,* the famous "Old Ironsides" of the War of 1812, is docked at the Charlestown Navy Yard. Nearby stands a monument commemorating the Battle of Bunker Hill, fought in Charlestown in 1775.

Brighton-Allston lies in northwestern Boston. Many students and families live in apartments and small houses in this neighborhood.

The south side is made up of Roxbury, Dorchester, the South End, Mattapan, and Jamaica Plain. These communities have many old, run-down houses and apartment buildings. The area's many African American and Hispanic churches, community theater companies, and social action groups reflect a strong sense of pride among the neighborhood's people.

Hyde Park and West Roxbury, with their streets of comfortable houses, resemble many New England suburbs. Many of the residents work for the city or state government.

Metropolitan area. The Boston metropolitan area, or Greater Boston, has nearly 3 $\frac{1}{2}$ million people, which is about half of the population of Massachusetts. About 130 cities and towns in Massachusetts and New Hampshire make up Greater Boston. Boston is by far the largest city in the metropolitan area, but more than 80 percent of the people in the area live outside the city. The city's population is unusually small in relation to the metropolitan area's population. Boston ranks only 20th among U.S. cities in population, but its metropolitan area ranks 7th.

© Steve Dunwe

Boston Common, the oldest public park in the United States, dates back to the 1600's. This popular park lies on the western edge of Boston's downtown area.

Greater Boston includes many historic cities and towns. Cambridge, on the north bank of the Charles River, is the home of Harvard University. Harvard, founded in 1636, is the country's oldest institution of higher learning. General George Washington first took command of the Continental Army on the Cambridge Common in 1775. Lexington, which lies northwest of Cambridge, is called "the birthplace of American liberty." In 1775, British troops killed eight minutemen on the Lexington village green in the first battle of the Revolutionary War.

Visitors to nearby Concord can see Minute Man Historical Park and the homes of authors Louisa May Alcott and Ralph Waldo Emerson. In Salem, northeast of Boston, 19 people accused of witchcraft were hanged on Gallows Hill during the 1690's. Today, the city's attractions include its quaint streets and houses, the Salem Witch Museum, and Pioneer Village.

The Boston metropolitan area and nine other metropolitan areas in Massachusetts, New Hampshire, Maine, and Connecticut make up a consolidated metropolitan statistical area called Boston-Worcester-Lawrence.

People

English Puritans and their descendants made up almost the entire population of Boston for over 200 years after the city was founded in 1630. Some rich Puritan families produced outstanding business leaders, educators, and writers. These families were known as the *Boston Brahmins.* The name came from the *Brahmins,* or *Brahmans,* who make up the highest *castes* (social classes) of the Hindu religion. Members of many of these families still live in the area.

But Boston has been a city of immigrants since the 1840's, when wave upon wave of Europeans began to pour into the city. Even today, Boston has a higher percentage of people born in other countries than do many other large U.S. cities.

Boston has one of the largest Roman Catholic communities in the country. The Unitarian-Universalist Association, an organization of Protestant churches, and the Church of Christ, Scientist, have headquarters in Boston.

Ethnic groups. Many of Boston's people are of Irish and Italian descent. African Americans make up one-fourth of the population. The city's ethnic groups also include people of Hispanic and Asian ancestry.

People of Irish ancestry began to pour into Boston by the thousands from 1845 to 1847 to escape starvation caused by the failure of Ireland's potato crop. In time, descendants of Irish immigrants gained political control in Boston. The Irish became one of the city's most prosperous and powerful ethnic groups.

Many people of Italian ancestry arrived in Boston from 1880 to 1914. During that period, cheap steamship service linked the city with eastern and southern Europe. The low fares attracted thousands of poor Italians, as well as many Lithuanians and Poles, to Boston. Most of the Italians settled in the North End.

African Americans from the Southern States began to move to the North in ever-increasing numbers after World War I ended in 1918. But Boston's depressed economy at that time could offer few jobs to the unemployed. Thus, fewer African Americans moved to Boston than to such cities as Chicago and Detroit, where factories were hiring many unskilled workers.

Education. Boston is the birthplace of public education in the United States. The Boston Latin School, the first public school in the Western Hemisphere, opened in 1635. Today, the Boston School Committee governs the city's public school system. The committee consists of seven members appointed by the mayor. The city also has many private schools.

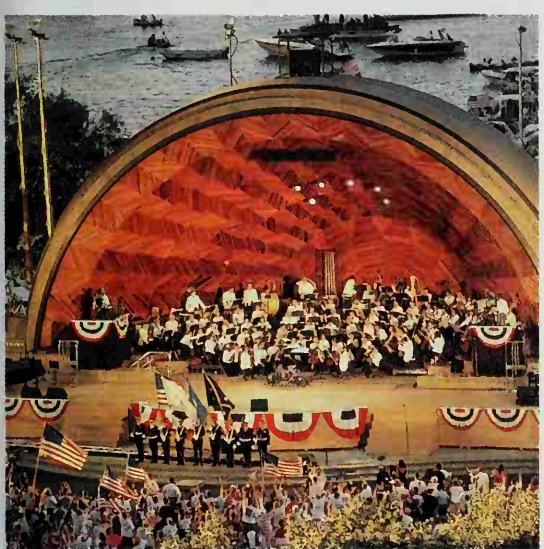
Greater Boston is one of the nation's leading centers of learning. It has many well-known colleges and universities. Harvard University and the Massachusetts Institute of Technology, both in Cambridge, have worldwide reputations for excellence. Other famous schools in Greater Boston include Boston College in Chestnut Hill, Brandeis University in Waltham, Tufts University in Medford, and Wellesley College in Wellesley. Institutions of higher education within the city of Boston include the Boston Architectural Center, Boston University, Massachusetts College of Art, Northeastern University, St. John's Seminary, and a branch of the University of Massachusetts. Boston also has a number of medical schools and junior colleges.

Social problems. Poverty and unemployment have been serious problems in Boston. Many kinds of jobs available in the city—in business, government, and scientific research—require highly educated workers. Many other people cannot find work because most of Greater Boston's factories have moved to suburban areas. Other problems include crumbling housing in poor neighborhoods and a severe housing shortage.

Cultural life and recreation

The arts. Boston has long been a great cultural center. The distinguished Boston Symphony Orchestra performs from mid-September through April at Symphony Hall in Back Bay. The Boston "Pops" Orchestra presents concerts of light music at Symphony Hall in May and June. The "Pops" gives free outdoor concerts during July in Hatch Memorial Shell on the Esplanade, a park on the south bank of the Charles River. The New England Conservatory of Music, the nation's oldest music school, also offers many concerts. The Boston Ballet and the Boston Lyric Opera have won critical acclaim.

The area's professional theater groups include the American Repertory Theatre in Cambridge. In addition,



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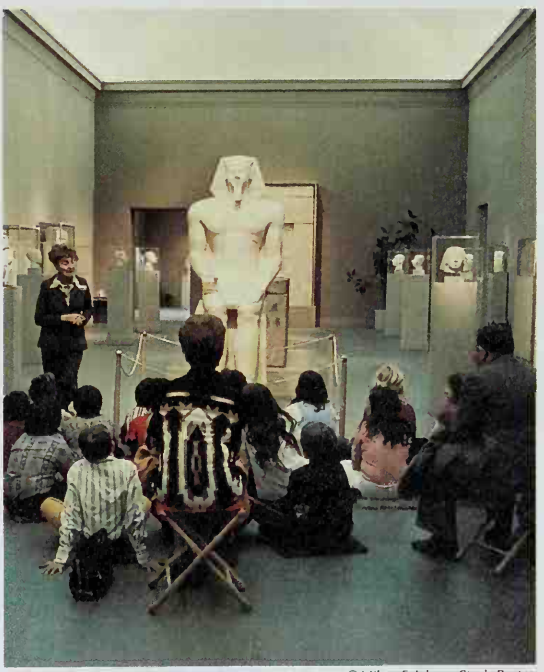
The Boston "Pops" Orchestra gives free outdoor concerts during July in Hatch Memorial Shell on the Esplanade, a riverbank park. The performance shown here celebrates the Fourth of July.



© Milton Feinberg, Stock, Boston

Boston's Museum of Fine Arts is the city's largest museum. Its outstanding collections include sculpture from ancient Egypt, *shown here,* Greece, and Rome.

dozens of community and college theater groups are active in Greater Boston.

Libraries and museums. The Boston Public Library, founded in 1854, was the first major free library in the United States. The massive main library in Copley Square is a city landmark. The Boston Athenaeum, a small, private library in the downtown area, has many rare volumes, including books owned by George Washington, the first president of the United States. The libraries at Harvard, the Massachusetts State House, and many Boston museums attract scholars from throughout the world. The John F. Kennedy Library has papers and mementos of the 35th president of the United States.

The Museum of Fine Arts, Boston's largest museum, stands in Back Bay. Its art collection represents nearly every culture of the last 5,000 years. The museum's large exhibits of American art; Asian art; ancient Egyptian, Greek, and Roman art; and French Impressionist paintings are especially outstanding. Nearby, the Isabella Stewart Gardner Museum houses Renaissance paintings and sculptures in a beautifully furnished mansion. The Institute of Contemporary Art in Back Bay and Harvard University's Fogg Museum also have fine art collections.

Boston's huge Museum of Science stands on the Charles River Dam Bridge. The museum has a dinosaur model, a machine shop, and displays of airplanes, ships, and spacecraft. The museum also includes the Charles Hayden Planetarium, which shows the movements of the stars and planets. The New England Aquarium on Central Wharf has hundreds of kinds of fish and other water animals. The Children's Museum in South Boston lets visitors operate a computer and make toy tops on an assembly line. The Arnold Arboretum in Jamaica Plain is a 265-acre (107-hectare) park and forest with thousands of kinds of trees and shrubs.

Recreation. Boston has more than 4,500 acres (1,820 hectares) of public parks. Franklin Park, the city's largest park, is in Dorchester. The park includes a main zoo, a children's zoo, and an African tropical forest. Nine public bathing beaches lie along Boston Harbor in the communities of Dorchester, East Boston, and South Boston. A massive harbor sewerage project, completed in 2000, greatly improved water quality.

Bostonians are enthusiastic fans of the city's four professional sports teams. The Boston Red Sox of baseball's American League, the Boston Celtics of the National Basketball Association, and the Boston Bruins of the National Hockey League play their home games in the city. The New England Patriots of the National Football League play in a south suburban stadium.

A traditional Boston sports event takes place on Patriots' Day, the third Monday in April. Thousands of people compete in the Boston Marathon, a foot race of 26 miles 385 yards (42.2 kilometers) from the suburb of Hopkinton to Back Bay.

Economy

Greater Boston is the largest industrial center in New England. After World War I (1914-1918), many factories moved from Boston to suburban areas where land was cheaper and more plentiful. Lynn, Quincy, and Waltham are now major industrial cities in Greater Boston.

In the city of Boston, the majority of workers have jobs in fields that provide services. For example, many people work for the area's numerous educational institutions, medical centers, and city and state government offices. Many other workers are employed in such fields as trade, finance, transportation, and communication.

Manufacturing. Greater Boston has thousands of factories. The area's major products include machinery, medical and optical instruments, processed foods, and a variety of high-technology products.

Printing also ranks among the area's important industries. Greater Boston has many book publishers, including several university presses.

Trade. The Port of Boston includes wharves in Charlestown, in East and South Boston, and on the North End. It is a leading New England port. The chief exports include electronic equipment, office equipment, paper products, scrap iron, and seafood. Leading imports include automobiles, beer and wine, footwear, iron and steel, and petroleum products.

The Boston area is the retail and wholesale trading center of New England. Greater Boston's retail stores employ tens of thousands of workers. Retail stores throughout New England and eastern Canada buy much of their merchandise from Greater Boston's large number of wholesale firms.

The city of Boston ranks as one of the world's busiest markets for wholesale wool. Boston is also a major fish market. Rich fishing waters lie off Boston's coast.

Finance. Boston is New England's financial capital. The city has a stock exchange and numerous banks. The First Federal Reserve District Bank and many insurance companies have their headquarters in Boston. The city is a major center for trading in mutual funds.

Transportation. Railroad freight lines and Amtrak's rail passenger service link Boston with major cities in the United States and Canada.

Boston's busy Logan International Airport lies less than 3 miles (5 kilometers) from downtown, on the eastern edge of East Boston.

The publicly owned Massachusetts Bay Transportation Authority (MBTA) transports hundreds of thousands of passengers each weekday in Boston and nearby cities and towns. The MBTA operates buses, streetcars, subways, trains, and trolley cars.

Boston has three main expressways—the Massachusetts Turnpike Extension, the Northeast Expressway, and the Southeast Expressway. They extend to the suburbs and carry most of the automobile traffic to and from the downtown area.

Communication. Boston's *Publick Occurrences Both Forreign and Domestick,* published in 1690, was the first newspaper in the American Colonies. Today, Boston has three daily newspapers—*The Boston Globe,* the *Boston Herald,* and *The Christian Science Monitor.* The *Monitor* is a highly respected national newspaper. Boston's many broadcasting outlets include a nonprofit television station associated with the national Corporation for Public Broadcasting.

Government

Boston's government is headed by a mayor and a 13-member City Council. The voters elect the mayor to a four-year term. Council members are elected to two-year terms. Nine council members are elected from districts. Four are elected by the voters on a citywide ba-

sis—that is, the members do not represent particular areas. Candidates for mayor and the City Council do not run for office under political party labels.

The mayor administers the city government and prepares the city budget. The council passes Boston's laws and may cut, but not increase, the city budget. The mayor has the power to veto bills passed by the council. But the council can repass a bill over the mayor's veto by a vote of two-thirds of its members.

Several Greater Boston government agencies provide services to Boston and many nearby cities and towns. The Metropolitan District Commission provides park and other recreational services. The Massachusetts Water Resources Authority provides a sewerage system and a water supply to participating communities for a fee. Other agencies that provide local services include the Air Pollution Control District and the Metropolitan Area Planning Council. The city's revenue comes from property taxes, state aid, and other sources.

History

Early settlement. Massachusett Indians lived in what is now the Boston area before the first Europeans settled there in 1630. By the time the European settlers arrived, the area's Indian population had been nearly wiped out by disease. From 1615 to 1617, epidemics of measles, scarlet fever, and other diseases killed about 2,500 of the 3,000 Indians in the area. The diseases had been carried to the New World by European explorers.

The promise of open land that could be settled without the threat of Indian raids attracted many English colonists to the Boston area. William Blackstone, the first European settler, built a cottage on what is now Beacon Hill in the 1620's. In 1630, a group of about 800 Puritans led by John Winthrop founded Charlestown, now part of Boston. Later that year, Winthrop and many of the settlers crossed the Charles River and founded Boston on a peninsula that the Indians called *Shawmut*. Boston became the capital of Massachusetts Bay Colony in 1632 (see Massachusetts Bay Colony).

Boston began as a tightly knit village of craftworkers, farmers, and ministers. The settlers had been persecuted in England for their Puritan beliefs. Yet the town's leaders tried to drive out of Boston any new settlers who did not share their beliefs. Only Puritans could vote or hold public office. Laws forbade the staging of plays and the celebration of Christmas. The Puritans considered cooking on Sunday a sin. Many Puritan women prepared baked beans every Saturday and served them for Sunday dinner. This custom earned Boston the nickname *Beantown*.

Despite the Puritans' restrictions, Boston grew rapidly. By 1720, it was a thriving town with about 12,000 people of various political and religious beliefs. By the mid-1700's, Boston had become a leading commercial, fishing, and shipbuilding center of the American Colonies. Wealthy merchants were now the town leaders, and most of the strict Puritan laws were forgotten.

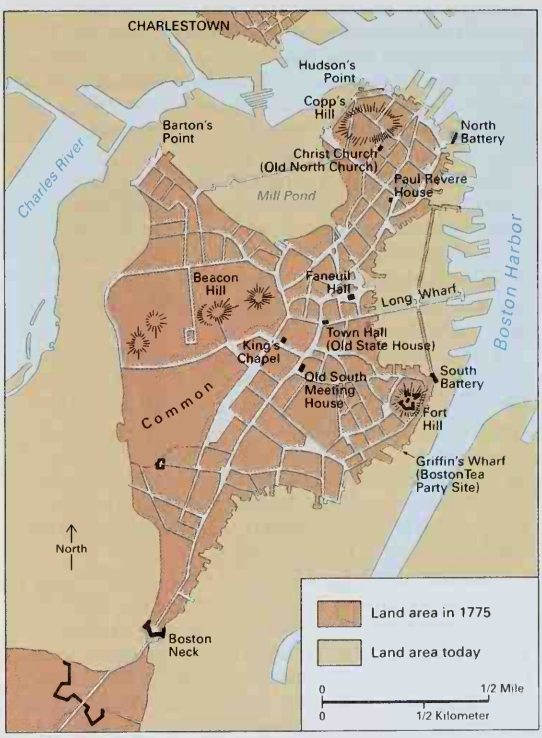
Resistance and revolution. Boston's patriots helped lead the colonies in their struggle for independence from the United Kingdom. In 1765, the British Parliament passed the Stamp Act, which required the colonists to pay a tax on newspapers, legal documents, and various other items. Angry Bostonians violently protested against this "taxation without representation." Mobs rioted and looted the homes of British officials.

In 1770, a street fight between a Boston mob and British soldiers resulted in what became known as the Boston Massacre. Soldiers fired into the mob, killing five men and wounding six others. The incident further embittered the colonists.

In 1773, a band of colonists staged the Boston Tea Party to protest a British tax on imported tea. Bostonians disguised as Indians crept onto British ships in Boston Harbor and dumped their cargoes of tea overboard. Three major clashes with British troops—the battles of Lexington, Concord, and Bunker Hill—occurred near Boston in 1775. In March 1776, General George Washington ordered his troops to occupy Dorchester Heights, which overlooks Boston. From Dorchester Heights, the patriots threatened to fire cannon at the British troops guarding Boston. This forced the British to flee the city. The capture of Boston was the first major American victory of the revolution.

Economic growth. After the Revolutionary War ended in 1783, Boston merchants began to build huge fortunes through foreign trade. Ships loaded with fish, rum, salt, and tobacco left Boston Harbor for ports throughout the world. The ships returned with silk and tea from China, sugar and molasses from the West Indies, and gold and mahogany from Africa.

Boston was chartered as a city in 1822. Between 1824 and 1858, several landfill projects more than doubled



WORLD BOOK map

Boston in 1775 occupied a peninsula between the Charles River and the Boston Harbor. Much of the water area has since been filled in. Many famous buildings, including Old North Church, King's Chapel, and Faneuil Hall, still stand.

the size of the Shawmut peninsula. The rapid growth of Boston's garment, leather goods, and machinery industries made the city one of the nation's leading manufacturing centers.

During the 1840's, more than 500,000 Irish immigrants fled to Boston to escape starvation in their homeland, where the potato crop had failed. The immigrants provided cheap labor for the city's factories, railroads, and wharves. Most of them lived in crowded, crime-ridden slums and faced discrimination and hostility from native Bostonians.

Boston became a center of literary activity during the 1800's. Such famous authors as Louisa May Alcott, Ralph Waldo Emerson, Nathaniel Hawthorne, and Henry Wadsworth Longfellow lived there and became close friends. William Lloyd Garrison started a powerful antislavery movement in Boston in the 1830's. His fiery newspaper, *The Liberator,* and Harriet Beecher Stowe's antislavery novel, *Uncle Tom's Cabin,* were both published in Boston.

On Nov. 9, 1872, a fire wiped out about 60 acres (24 hectares) of downtown Boston. The area was soon rebuilt, and the city continued to grow. The nation's first subway opened in Boston in 1897. By 1900, the city's population had reached about 560,000.

Rise of Irish politicians. In the early 1900's, the descendants of Irish immigrants began to dominate Boston's politics. John F. (Honey Fitz) Fitzgerald, grandfather of President John F. Kennedy, served two terms as Boston's mayor, in 1906 and 1907 and from 1910 to 1914. During his terms, the city enlarged City Hall, modernized the Port of Boston, and built the Franklin Park Zoo. James Michael Curley, another powerful Irish politician, served four terms as mayor between 1914 and 1950. After taking office, both men found or made jobs for their Irish supporters and so increased the economic and political power of the city's Irish people.

Decline and urban renewal. During the 1940's and 1950's, a new system of highways and expressways was built in and around Boston. But the business district and some neighborhoods in the city declined. Thousands of families and businesses moved to the suburbs. Boston's population dropped from more than 800,000 in 1950 to about 563,000 in 1980.

A large-scale urban renewal program began in the early 1960's. The city, state, and federal governments spent about $465 million to improve more than 2,500 acres (1,010 hectares) of land. The program included the construction of Government Center and Prudential Center and the remodeling of run-down housing in many neighborhoods. A major building and restoration program began in the residential section just south of the downtown area in the mid-1970's.

Conflict over schools. In June 1974, a federal court ruled that the Boston School Committee had deliberately maintained racial segregation in the city's public school system. The court ordered the immediate desegregation of Boston's public schools. But in the fall, more than 10 percent of the city's public school students did not register for classes. Many who registered stayed away after fights broke out between blacks and whites in school and on nearby streets. A total integration program begun in September 1975 required the busing of over a fourth of Boston's public school students. Some white parents protested violently and enrolled their children in private schools.

In the 1990's, state and city officials pressed school reform efforts, and public school enrollment began to grow again. In 1999, the Boston School Committee voted to end race-based school busing.

Building boom. In the early 1980's, Boston's downtown area experienced a construction boom. A number of office and residential buildings went up. The new construction, combined with the high cost of commuting and Boston's lowered property taxes, made city living attractive. The decline in Boston's population stopped. By 1990, the population had reached 574,283.

Work began in the early 1990's on an enormous and costly public works project that was called the "Big Dig." The goal of the project was to replace the elevated 6-lane Central Artery, the section of Interstate 93 that cut through downtown, with an underground highway of 8 to 10 lanes. Plans called for the development of park areas on the land where the Central Artery stood.

One phase of the project was completed in 1995 when the Ted Williams Tunnel under Boston Harbor opened. The tunnel, named for the famous Boston Red Sox ballplayer, connected the Massachusetts Turnpike with Logan International Airport.

Developments in the early 2000's. By 2000, Boston's population had increased to 589,141. The groundbreaking for a massive new convention center in South Boston took place in 2000. Work also began on a residential and office development along Boston Harbor between the convention center and downtown Boston. These major construction projects, the Big Dig, and thriving businesses provided many jobs for Boston workers.

Robert L. Turner

Related articles in *World Book* include:

Adams, John
Architecture (picture: Early American architecture)
Boston Massacre
Boston Port Act
Boston Post Road
Bunker Hill, Battle of
Curley, James Michael
Faneuil, Peter
Garrison, William Lloyd
Massachusetts (pictures)
Old North Church
Revere, Paul
Winthrop, John

Outline

I. The city
- A. Downtown Boston
- B. Back Bay
- C. Beacon Hill
- D. The North End
- E. South Boston
- F. East Boston
- G. Charlestown
- H. Brighton-Allston
- I. The south side
- J. Hyde Park and West Roxbury
- K. Metropolitan area

II. People
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III. Cultural life and recreation
- A. The arts
- B. Libraries and museums
- C. Recreation

IV. Economy
- A. Manufacturing
- B. Trade
- C. Finance
- D. Transportation
- E. Communication

V. Government

VI. History

Questions

What major Revolutionary War battles occurred near Boston?
Where is the Ted Williams Tunnel?
What was Boston Common originally used for?
Why is the Boston Latin School noteworthy?
What is the Freedom Trail?
How did Boston increase its area in the 1800's?
What is the Boston "Pops"?
When does the Boston Marathon take place?
Who founded Boston?
What Boston newspaper was the first newspaper in the American Colonies?

Boston Massacre was not a massacre but the killing in a street clash of several colonists by a squad of British soldiers. The incident took place on March 5, 1770. Speechmakers invented the name *Boston Massacre* and used it to rally the colonists against British policies. The massacre was one of the events that led to the Revolutionary War in America.

The assignment of British troops to Boston in 1768 had upset local citizens. A riot began when 50 to 60 people threatened a British sentinel. Captain Thomas Preston, a British officer, brought several soldiers to his assistance. By that time, the crowd had grown to about 400 people and was pressing close to the soldiers. The soldiers then fired into the crowd, killing three people and wounding eight others, two of whom died later.

The angry citizens of Boston demanded the removal of the British troops and the trial of Captain Preston and his men for murder. British authorities in Boston agreed to these demands. At Preston's trial, John Adams and Josiah Quincy were counsel for the defense. It could not be proved that Preston ordered his troops to fire, and he was acquitted. Two of Preston's soldiers were later found guilty of manslaughter. They were branded on their thumbs as punishment. James Kirby Martin

See also Adams, John (In New England); Attucks, Crispus.

Boston Port Act was a law passed by the British Parliament in 1774. It was one of four laws that were intended to punish the citizens of Boston for their destruction of tea in Boston Harbor on Dec. 16, 1773. The Boston Port Act went into effect on June 1, 1774. It altered the Massachusetts Charter of 1691 to give Britain (now called the United Kingdom) greater control over the colony. The act also closed the port of Boston. The four laws that include the Boston Port Act, together with the Quebec Act, are usually called the *Intolerable Acts* or the *Coercive Acts.* They aroused great anger in all the colonies. Many of the colonial legislatures offered to help Massachusetts if it continued to defy Britain. The Boston Port Act was thus one of the causes of the Revolutionary War in America (1775-1783). Donna J. Spindel

See also Boston Tea Party; Intolerable Acts.

Boston Post Road was any of the first three mail routes to serve colonial America. These roads ran between Boston and New York City. The journey on horseback between the two cities could take as long as two weeks. The original Boston Post Road, later called the Upper Road, went into use in 1673. Two other mail routes were known as the Middle and Lower roads.

The Upper Road ran from Boston west through Worcester and Springfield, Mass. Then it turned south through Hartford and New Haven, Conn., and continued south along the east coast to New York City. The Middle Road extended from Boston southwest to Pomfret, Conn., and then to Hartford, where it joined the Upper Road. The Lower Road ran from Boston to Providence, R.I., and south along the coast through Old Saybrook,

The Bloody Massacre Perpetrated in King Street (1770); American Antiquarian Society, Worcester, Mass.

The Boston Massacre greatly aroused the anger of Boston residents against British troops in the city. This picture, accompanied by a patriotic poem which deplored the event, was engraved, printed, and sold by Paul Revere. The picture is not an accurate portrayal of the Boston Massacre.

Conn. The Lower Road joined the Upper and Middle roads in New Haven. The route of the Lower Road partly followed that of today's U.S. Highway 1.

William Morgan Fowler, Jr.

Boston Tea Party was a raid by American colonists on three ships in Boston Harbor on Dec. 16, 1773. Colonists disguised as Indians emptied 342 chests of tea into the harbor to avoid payment of a British tax on tea. The British response helped unify the colonists and brought the colonists closer to movement for American independence.

In 1767, the British Parliament had placed *duties* (import taxes) on several items imported into America. Many colonists considered such taxes to be illegal and were determined not to pay them. In 1770, the British government repealed all the duties except for one on imported tea. In 1773, Parliament passed the Tea Act to help get the East India Company, a British trading company, out of financial trouble. This act enabled the company to sell tea in America at a low price. But the tea was still subject to the duty established in 1767. Soon the tea was shipped to America for distribution to agents of the East India Company, who were given a monopoly on its sale. Colonists feared the tea monopoly would put some of their patriotic local merchants out of business. In addition, the colonists thought that if they paid the duty on tea, the British would impose other taxes on them.

After the tea ships arrived in Boston Harbor, the colonists tried to get them sent back to England. Those efforts were rejected by Governor Thomas Hutchinson, leading to the Boston Tea Party. At a signal perhaps given by resistance leader Samuel Adams, an unknown number of men, possibly 100 or more, boarded the ships and dumped the tea overboard. The British government reacted in 1774 by passing several harsh measures that became known as the Intolerable Acts. These acts united the opposition to British rule and led to the First Continental Congress, a gathering of representatives from 12 of the American Colonies.

Pauline Maier

See also **Adams, Samuel; Boston Port Act; Hutchinson, Thomas; Intolerable Acts.**

Engraving (1800's) (Granger Collection)

The Boston Tea Party was a protest against a tax the British government placed on imported tea. On Dec. 16, 1773, some colonists dressed as Indians boarded three ships and emptied chests of tea into Boston Harbor.

Boston terrier is a small dog with a smooth dark coat. It has a white chest and neck, and white feet. The Boston terrier has a square head and a short nose. The dog weighs about 12 to 25 pounds (5.4 to 11 kilograms). The Boston terrier is a popular pet because it likes people. The breed was started in Boston in 1870. See also **Dog** (picture: Nonsporting dogs); **Terrier.**

Critically reviewed by the American Kennel Club

Boswell, *BAHZ wehl,* **James** (1740-1795), was a Scottish author who wrote what is probably the most brilliant biography in the English language, *The Life of Samuel Johnson* (1791). Although his fame rests chiefly on his association with Johnson, the greatest English writer of the time, Boswell revealed his fascinating personality in many other writings. His lively private journals record his most intimate thoughts and experiences. In astonishing detail, the journals describe the contradictory character of Boswell—lively and moody, lustful and devout, vain and affectionate.

Boswell was born in Edinburgh, the son of a distinguished judge who wanted his son to work in the law. But Boswell's ambition was to win fame as an author and to move in the society of great men. In 1763, in a small London bookshop, Boswell met Johnson. Between 1763 and 1766, Boswell traveled in Europe and met the great French writers Voltaire and Jean-Jacques Rousseau. He also met the Corsican patriot Pasquale Paoli, and enthusiastically supported Corsica's fight for independence from the republic of Genoa. Boswell's *Account of Corsica* (1768) made him famous.

Detail of oil portrait by Sir Joshua Reynolds, National Portrait Gallery, London

James Boswell

Boswell began to practice law in Edinburgh in 1766, but the lure of London and Johnson's stimulating company prompted frequent visits. In 1773, he invited Johnson on a tour of the Hebrides Islands of Scotland. Boswell's *Journal of a Tour to the Hebrides* (1785) is a colorful account of their trip.

After Johnson died in 1784, Boswell, assisted by the great scholar Edmund Malone, began the difficult task of writing his friend's biography. Boswell probably had decided to undertake this project soon after he met Johnson. During the many years of their friendship, he had tirelessly collected materials on Johnson's life, filling his journals with authentic transcriptions of Johnson's conversations. This dili-

gence—and Boswell's skill in transforming the various incidents of Johnson's life into a unified work of art—resulted in a new type of vivid biography. Boswell did not merely record facts and dates, and he did not conceal the blemishes of his friend's character to glorify him. He followed Johnson's belief—that through biography, readers may learn by example how to copy the virtues and avoid the follies of even the greatest people.

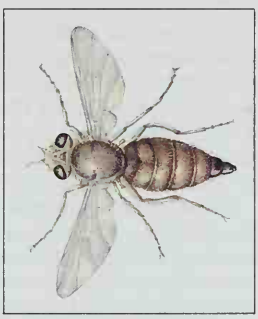
Boswell's supreme achievement was to bring Johnson to life, allowing him to speak for himself in his letters and his conversation. Thanks to Boswell's memory, his sense of the dramatic, and his keen ear for intonations, Johnson and his words are, as Boswell had hoped, "almost entirely preserved." Gary A. Stringer

See also **Johnson, Samuel.**

Bot fly is the name of various kinds of harmful flies. Their *larvae,* called *maggots,* live as parasites in livestock, wild animals, and human beings (see **Larva**). These maggots eat the tissues or fluids of the living body. The infestation of fly maggots in people or in animals is called *myiasis.* Many animals die from infestation with bot fly maggots. Human beings may be seriously affected.

The *horse bot flies* are among the most common types of bot flies in the United States. The female flies lay their eggs on the hair of the horse's legs or jaws, or on or near the lips. The eggs hatch into maggots called *bots,* which enter the body of the horse. They work their way to its stomach, where they irritate the stomach lining and cause digestive disturbances.

Another group of bot flies, called *heel flies* or *warble flies,* lay their eggs on the legs or hindquarters of cattle. The larvae, known as *cattle grubs,* burrow through the skin and travel through the body until they reach the back. They make holes in the skin, through which they breathe while they develop just under the surface. They remain inside the infested animal as they develop and grow for nearly a year before they leave its body, dropping to the ground to develop further.



WORLD BOOK illustration by Shirley Hooper, Oxford Illustrators Limited

Bot fly

The *sheep bot fly* deposits its larvae in the nostrils of sheep and goats. The larvae crawl into the cavities of the nose and the head sinuses. They leave the animal's body later to complete their development.

Insecticides are used to kill bot flies in horses. These insecticides are given by mouth in a capsule or stomach tube. Some insecticides that are sprayed or poured on are effective against grubs in beef cattle. Various chemicals are injected into the sinuses of sheep to kill grubs.

The bot flies that infest human beings are found in the tropics. The female bot fly catches a mosquito, some other bloodsucking fly, or a tick and attaches its eggs to the captured animal's abdomen. These eggs hatch into bots. When the infested animal bites a human being, the bots enter the person's skin.

Scientific classification. Bot flies belong to the order Diptera. Horse bot flies belong to the family Gasterophilidae. Cattle bot flies belong to the warble fly family, Hypodermatidae. The sheep bot fly belongs to the family Oestridae. E. W. Cupp

See also **Warble fly.**

Botanic Garden, United States, in Washington, D.C., exhibits more than 10,000 plants, including over 2,000 rare species and varieties. The collection includes products of the United States and other countries. The garden is located on the southwest side of Capitol Hill.

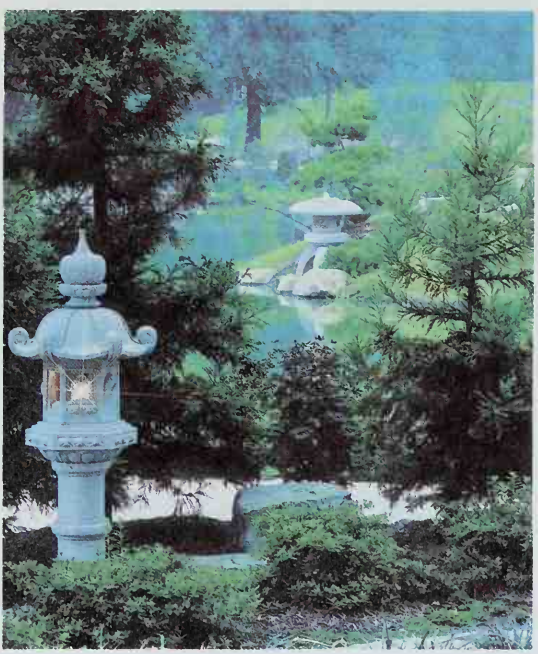
As a public service, the garden identifies plants and recommends a method of growing them. It also presents special displays, courses in horticulture, and guided tours of the conservatory.

A private organization founded the botanic garden in 1820. In 1842, the government assumed control of the garden to display botanical collections assembled by government expeditions. The Congressional Joint Committee on the Library has supervised the United States Botanic Garden since 1856.

Critically reviewed by the United States Botanic Garden

Botanical garden, *buh TAN uh kuhl,* is a garden in which plants are grown chiefly for scientific, educational, and artistic purposes. Botanical gardens usually are part of an institution or other center of learning devoted to the study of plants. They often have courses for adults on the uses of plants. In some gardens, children may learn about plants from skilled teachers.

There are various types of botanical gardens in the United States. For example, the New York Botanical Garden in New York City and the Missouri Botanical Garden in St. Louis have year-round displays of plants from many parts of the world. The Brooklyn Botanic Garden



Jack Zehrt

The Missouri Botanical Garden in St. Louis displays plants from all parts of the world. The Japanese garden shown above consists of a wide variety of plants.

specializes in publishing horticultural information. Other gardens feature native local plants.

Canada has several noted botanical gardens. One in Hamilton, Ontario, has a spectacular rock garden and a separate 25-acre (10-hectare) garden for children. Others include the beautiful Butchart Gardens near Victoria, British Columbia, and the Montreal Botanical Garden.

Famous gardens in other countries include the Jardin des Plantes in Paris and the United Kingdom's Royal Botanic Gardens in Kew, England. The rubber industry originated in part from studies made at Kew Gardens (see **Rubber** [The first plantations]). David H. Wagner

See also **Arboretum; Floriculture; Botanic Garden, United States.**

Botany, *BAHT uh nee,* is the branch of biology concerned with the study of plants. More than 260,000 species of plants grow in all parts of the world. Scientists called *botanists* study all aspects of plant life, including where plants live and how plants grow.

What botanists study

Botanists focus on four broad areas in their research: (1) plant classification and form, (2) how plants function, (3) plant habitats, and (4) the uses of plants. Most botanical research involves more than one and sometimes all of these areas. In addition, each of the areas includes various specific fields of study. Because the plant kingdom is so diverse, most botanists focus on one or more specialized fields.

Plant classification and form provides the framework for almost all fields of botany. In studying a plant, a botanist must first know what type of plant it is. Botanists who specialize in *systematics* identify plant species. This field includes *taxonomy,* the science of naming and classifying plants. Botanists who specialize in *morphology* examine the form and structure of plants. Their research includes investigations of the cells and tissues that make up a plant's internal structure.

How plants function. Plants must carry out a variety of activities to remain alive. Botanists specializing in *physiology* study the processes that enable plants to grow and reproduce. These botanists examine how plants make and use food by photosynthesis, and how they obtain water, minerals, and nutrients from the soil. Much of their work focuses on the chemical processes that take place in the molecules in cells.

© Hank Morgan

Botanical research benefits many fields. These botanists are examining lettuce raised indoors by *hydroponics,* a method of growing plants in a nutrient solution instead of soil.

© Ray Ellis, Photo Researchers

© Jeremy Burgess, SPL from Photo Researchers

Using an electron microscope, a botanist studies minute features of a plant's structure. Two tiny *stomata* (pores) on a tobacco leaf are visible in the photograph at right. The stomata are magnified about 250 times.

Botanists specializing in *genetics* study how plants pass characteristics on to their offspring through *genes* (hereditary material). Botanists studying *molecular biology* examine how genes affect plant form and function. They also study how genes may be altered to change plants or to create new plants through a process called *genetic engineering* (see **Genetic engineering**).

Plant habitats are studied by botanists who specialize in *ecology* and *geography.* Plant ecologists study the relationship between plants and their environment. They also examine how plants interact with one another and with animals. Plant geographers study where plants live. They try to explain why certain plants grow in a particular region, but others do not.

Uses of plants. The search to find ways that people may use plants is the oldest area of study in botany. Botanists who study *agronomy* develop and improve crop plants. Those who specialize in *forestry* study trees, especially the cultivation of trees for use in the manufacture of lumber, paper, and other products. *Horticulture* is the cultivation of fruits, vegetables, flowers, and ornamental shrubs and trees. *Medical botany* is the science of using plants to treat diseases.

The importance of botany

The study of plants is vitally important because all of the food that people and animals eat comes from plants, either directly or indirectly. Except for certain species of bacteria, plants are the only organisms that can make their own food. They do so by the process of photosyn-

thesis. As a result, plants form the base of nature's *food chain,* the system by which energy is transferred from one organism to another in the form of food. Since the earliest times in human history, people also have used plants as medicine, as material for building, and as a means of beautifying their surroundings.

Botany also increases understanding of all forms of life. Through studies of plants, scientists learn how plants, animals, and other organisms interact with one another. They also learn how living things have developed and changed through time.

Research by botanists benefits people in a great variety of ways. For example, some botanists study plant genetics to develop new crop plants that are more productive and resistant to pests and diseases. Other botanists use findings in plant ecology to develop ways of improving the lumber industry while minimizing harm to the environment. Still other botanists study fossils of extinct plants to provide clues to the earth's history and to help geologists searching for oil.

The history of botany

Beginnings. People have always been interested in plants and have used them in many ways. Prehistoric people gathered wild plants for food and used plants to build shelters. By about 8000 B.C., people in the Middle East had begun to depend on cultivated plants for most of their food. Prehistoric people also raised plants for their beauty and used plants for medicine and in religious ceremonies.

The ancient Greeks and Romans made the first scientific studies of plants. The Greek philosopher Aristotle, who lived during the 300's B.C., collected information about most of the then-known plants of the world. His pupil Theophrastus classified and named these plants. Theophrastus is often called the father of botany. Pliny the Elder, a Roman naturalist and writer who lived from A.D. 23 to 79, recorded many facts about plants in his 37-volume reference work *Historis Naturalis (Natural History).* The knowledge gained by these scholars served as the foundation of botany for more than 1,000 years.

The development of modern botany began during the Renaissance, a 300-year period of European history that started in the A.D. 1300's. During this period, European exploration of the world greatly stimulated the study of botany and other sciences. Explorers discovered many new types of plants and brought them to scholars to examine and identify. As a result, modern botany developed around such basic research areas as the classification of plants and the study of their form and function. These areas gradually expanded into many specialized fields as botanists focused on more specific aspects of plant life.

Over the centuries, scientists developed many different systems to classify plants. But most of these systems proved inadequate as knowledge about plants increased and new plants were found. During the mid-1700's, the Swedish naturalist Carolus Linnaeus developed a system of naming plants that eventually became accepted as a standard classification system. Linnaeus used a *binomial system of nomenclature,* in which each plant has a unique name consisting of two parts. This system has been modified and expanded into the classification system used today. See **Classification, Scientific.**

The study of plant form made great advances during the 1600's, after the development of the compound microscope. The first scientists to observe the microscopic structures of plants included Marcello Malpighi of Italy and the Englishmen Robert Hooke and Nehemiah Grew. Also during the 1600's, research on plant function began with the work of Johann Baptista van Helmont, a Flemish doctor and chemist. Van Helmont made discoveries on how plants obtain food and grow.

Later developments. The study of plant ecology grew from research on the geographic distribution of plants. The German naturalist and geographer Alexander von Humboldt made major contributions to the development of plant geography. He traveled throughout the world during the late 1700's and early 1800's and mapped plant distributions. Modern ecology, which includes the study of both plants and animals, emerged in the late 1800's and early 1900's. Pioneers in this field included the American scientists Frederick Clements, Henry A. Gleason, and Robert Wittaker.

Research by the Austrian botanist Gregor Mendel during the second half of the 1800's had a tremendous impact on the study of botany and other fields of science. His experiments on the breeding of garden peas established the basic laws of heredity.

In the 1900's, scientists working in plant genetics and molecular biology made many spectacular discoveries. For example, through research on corn plants, the American geneticist Barbara McClintock found that certain genes can move around within the chromosomes of cells. This discovery, announced in 1951, greatly added to understanding of how plants and other organisms inherit their traits.

During the late 1900's and early 2000's, many botanists began to use new genetic techniques, including studies of the hereditary material DNA. These techniques enabled the scientists to define plant species and determine the relationships among the species with greater precision. A small but growing number of botanists came to regard Linnaeus's classification system as outdated and unworkable. They argued that botanists should revise how they name and classify plants, replacing Linnaeus's groupings with a *phylogenetic system* of

Runk/Schoenberger from Grant Heilman

A field botanist uses a laser scanner and computer to help record the progress of a diseased apple tree. The scanner identifies the tree by beaming light across a special coded tag. The botanist enters other information into the handheld computer.

classification. A phylogenetic system would be based on the evolutionary relationships among the organisms, where known.

Careers in botany

Botany offers a wide range of career opportunities. Most botanists work either for government agencies or for private industry as research scientists, laboratory technicians, or field botanists.

Most careers in botany require a master's degree. A doctor's degree is needed to do advanced research or to teach botany at a university. William A. DiMichele

Related articles in *World Book.* See Plant and its list of *Related articles.* See also the following:

Biographies

Bailey, Liberty H.
Brown, Robert
Burbank, Luther
Carver, George W.
Gray, Asa
Lamarck, Chevalier de
Linnaeus, Carolus
Mendel, Gregor J.
Peattie, Donald C.

Other related articles

Agronomy
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Grass
Horticulture
Mushroom
Paleobotany
Paleontology
Parasite
Photosynthesis
Shrub
Tree
Vegetable
Weed

Additional resources

Attenborough, David. *The Private Life of Plants.* Princeton, 1995.
Balick, Michael J., and Cox, P. A. *Plants, People, and Culture: The Science of Ethnobotany.* W. H. Freeman, 1996.
Bell, Peter R., and Hemsley, A. R. *Green Plants: Their Origin and Diversity.* 2nd ed. Cambridge, 2000.
Dow, Lesley. *Incredible Plants.* Time-Life Bks., 1997. Younger readers.
King, John. *Reaching for the Sun: How Plants Work.* Cambridge, 1997.

Botany Bay is a body of water about 5 miles (8 kilometers) wide on the east coast of Australia. It lies about 5 miles south of Sydney. The bay is formed by the mouths of the Cook's and George's rivers. It is partially separated from the Pacific Ocean by Cape Banks and Cape Solander, which are about 1 mile (1.6 kilometers) apart. In 1770, the British explorer James Cook became the first European to reach the bay. The bay was named for the many unusual plants growing on its shores. The British planned a penal colony on the bay in the 1780's but moved it to Sydney Harbour. Sydney suburbs now border the bay, which is a major port and the site of many industries. A monument on the south shore marks the site of Cook's landing. D. N. Jeans

Botfly. See Bot fly.

Botha, *BOH tuh,* **Louis,** *loo EE* (1862-1919), was the first prime minister of the Union of South Africa, from 1910 to 1919. He had fought the British in South Africa as a Boer general in the Boer War (1899-1902). Most Boers, including Botha, were of Dutch descent. After the Boers lost the war, Botha tried to forget the past and unite the Boer and British people against South Africa's black majority. While Botha was prime minister, his government passed laws to prevent blacks from owning land and from competing with Europeans for jobs. Botha supported the United Kingdom in World War I (1914-1918). He was born in Natal province. Bruce Fetter

Botha, *BOH tuh,* **Pieter Willem,** *PEE tur VIHL uhm* (1916-), served as the head of South Africa's government from 1978 to 1989. He became prime minister in 1978. In 1984, when South Africa's government was reorganized, Botha was elected state president.

Botha entered Parliament in 1948 and became minister of defense in 1966. He gained a reputation as a tough and ruthless leader. After becoming prime minister, he faced growing opposition to *apartheid,* the government's racial segregation policy. Botha unexpectedly relaxed or repealed several apartheid laws. He also led efforts to restructure the government. In 1984, Parliament was changed to include representation for the nation's *Coloured* (mixed-race) and Asian populations. But black people were excluded from the new Parliament.

Many black people staged demonstrations, and some rioted, to protest their continued exclusion. Botha used police and military forces to crush these outbreaks. Many countries restricted trade with South Africa to protest Botha's actions, but he maintained his harsh policies. Criticism from white South Africans grew. In 1989, Botha suffered a stroke and resigned as state president.

Botha was born in the Paul Roux district, near the town of Bethlehem, South Africa. He studied law at the University of the Orange Free State. John Lambert

See also South Africa (The dismantling of apartheid).

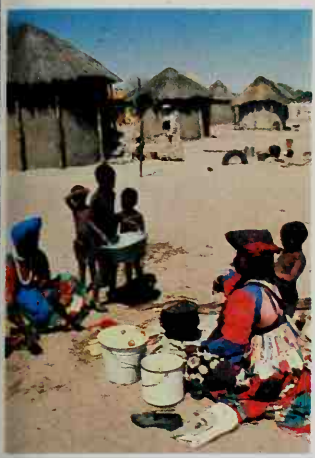
Bothwell, *BAHTH wehl,* **Earl of** (1536?-1578), a Scottish Protestant nobleman, was the third husband of Mary, Queen of Scots (see Mary, Queen of Scots). When Mary married Lord Darnley in 1565, she recalled Bothwell from exile in France. In 1567, Bothwell murdered Darnley. Bothwell was acquitted in a mockery of a trial, from which he forcibly excluded the chief witnesses against him. He seized Mary, perhaps with her consent, and took her to Dunbar. A month later, after divorcing his wife, the sister of the Earl of Huntly, he married the queen. Three days before the wedding, Mary had made him Duke of Orkney and Shetland.

Many lords of Scotland, both Protestant and Roman Catholic, united in opposition to the marriage. When the armies met at Carberry Hill near Edinburgh in June 1567, Bothwell's forces scattered, and the queen was taken prisoner. Mary insisted Bothwell be allowed to escape. He fled to Norway but was later captured. He became insane and finally died in a Danish prison. His given and family name was James Hepburn. Richard L. Greaves

Botswana, *boh TSWAH nah,* is a country in the center of southern Africa. Its official name is the Republic of Botswana. Botswana has a democratic form of government. Until the early 1990's, it was one of the few African nations with more than one political party. A number of other nations then began adopting multiparty systems. Botswana is a member of the Commonwealth, an association of former British colonies.

Botswana lies far from the sea and is surrounded by land. It is one of the most thinly populated countries in Africa. Botswana covers 224,607 square miles (581,730 square kilometers), but it has a population of only about 1 $\frac{1}{2}$ million. Most of the people live in eastern Botswana. The Kalahari Desert covers much of the rest of Botswana. Gaborone is the capital and largest city.

Government. Botswana is a republic headed by a president. The National Assembly, the country's chief legislative body, elects the president to a five-year term.



© Tom Nebbia, Woodfin Camp, Inc.

Botswana is a thinly populated country in southern Africa. Most of its people live in rural villages, such as the one at the left. The Kalahari Desert covers most of central and southwest Botswana. At the right, a herder's livestock gather in a part of the desert that has vegetation.

The Assembly has 38 voting members. The people elect 34 of them, and the Assembly itself elects the other 4. Assembly elections must be held at least once every five years. Citizens who are at least 21 years old may vote. The president selects a cabinet from the National Assembly. The House of Chiefs, made up of the leaders of the nation's major ethnic groups, advises the government on matters that affect ethnic customs.

Botswana has several political parties. The Botswana Democratic Party is the most powerful. The Botswana National Front is the largest opposition party. Other political parties include the Botswana People's Party and the Botswana Independence Party.

People. Most of Botswana's people live in rural areas. But thousands of them move to cities yearly. Most of the rural people live in large villages and make their living by farming or raising livestock. There are two major ethnic groups in Botswana, the Tswana and the Kalanga. The Tswana make up about 66 percent of the population, and the Kalanga form about 13 percent. Many Africans from South Africa, Zambia, and Zimbabwe also live and work in Botswana.

Botswana also has about 30,000 San (also called *Bushmen* or *Basarwa*). Only about 100 of them still live by hunting and gathering food. The rest live in permanent settlements or work on cattle farms. See **San**.

Botswana's population also includes a large number of *expatriates*—a word used in Botswana to refer to residents who are not black Africans. The expatriates include Europeans, white South Africans, and Asians. Some of the whites own ranches. Other expatriates hold technical or managerial jobs in the nation's mining industry or in business or government. In general, the expatriates earn higher incomes and enjoy better standards of living than do the ethnic groups native to Botswana. This situation causes some resentment. But the government declares it has a nonracist policy. It argues that the skills and capital of expatriates are needed to help the economy grow.

English is Botswana's official language, but most of the people speak *Setswana*, a Bantu language (see **Bantu**). About 15 percent of the people are Christians. Most of the rest of the people practice traditional African religions. Almost all of Botswana's children attend elementary school, and about half go on to high school. The University of Botswana is in Gaborone. Botswana also has several teacher-training colleges.

Unemployment is a major problem in Botswana. About 40,000 Botswana citizens, most of them young men, work in neighboring African countries, mainly South Africa. This arrangement brings much-needed foreign currency into Botswana, but it separates families and creates other social problems.

Poor housing is also a problem in Botswana, especially in such mining towns as Orapa and Selebi-Pikwe, where the poor live in overcrowded villages. The government is seeking ways to reduce unemployment and improve housing.

Land and climate. Botswana lies on a huge plateau and has an average altitude of about 3,300 feet (1,010 meters) above sea level. The land is hilly in the east and flat or gently rolling elsewhere. Eastern Botswana has the most fertile land, and about 80 percent of the people

Facts in brief

Capital: Gaborone.
Official language: English.
Area: 224,607 mi² (581,730 km²). *Greatest distances*—north-south, 625 mi (1,006 km); east-west, 590 mi (950 km).
Elevation: *Highest*—Otse Mountain, 4,886 feet (1,489 meters) above sea level. *Lowest*—near junction of Shashe and Limpopo rivers, 1,684 feet (513 meters).
Population: *Estimated 2002 population*—1,661,000; density, 7 per mi² (3 per km²); distribution, 51 percent rural, 49 percent urban. *1991 census*—1,326,796.
Chief products: *Agriculture*—beef, corn, cottonseed, hides and skins, milk, millet, onions, oranges, peanuts, sorghum, wheat. *Mining*—coal, cobalt, copper, diamonds, nickel.
National anthem: "Fatshe La Rona" ("Blessed Country").
Flag: Three horizontal bands (blue, black, and blue) are divided by two white bands. See **Flag** (picture: Flags of Africa).
Money: *Basic unit*—pula. One hundred thebe equal one pula.

live there. Forests cover parts of the north. The Kalahari Desert occupies almost all the central and southwest areas of the country. Bushes and grass grow in most of the Kalahari, but the southwest has sand dunes and little plant life.

The Okavango River rises in Angola and flows into northwestern Botswana. There, the river divides into streams and forms the Okavango Swamps.

Botswana has a dry, subtropical climate. In summer, which lasts from October to April, daytime temperatures often reach 100 °F (38 °C). Winter days are warm, but the temperature often falls below freezing at night. Average annual rainfall ranges from 22 inches (56 centimeters) in the east to 12 inches (30 centimeters) in the west. Droughts occur frequently.

Economy. Botswana is a poor country, but its economy is developing rapidly. The nation's two chief industries are mining and the raising of livestock, especially cattle. Copper, diamond, and nickel deposits were discovered in Botswana in the late 1960's and the 1970's and are being developed today. Botswana also has deposits of coal and cobalt. Farmers raise corn, millet, sorghum, and other crops. Botswana is developing its manufacturing through government encouragement of private enterprise and foreign investment.

Botswana's chief exports are beef, diamonds and other mineral products, hides and skins, and textiles. Leading imports include chemicals, food, fuel, machinery, and transportation equipment. Botswana's chief trading partners are South Africa, the United Kingdom, the United States, and Zimbabwe.

Botswana's economy depends heavily on South Africa for investments, markets, and technical skills. Most of Botswana's imports and exports travel on a railroad that runs through South Africa to the sea.

Botswana has about 9,300 miles (15,000 kilometers) of roads, most of which are unpaved. Airports serve Francistown, Gaborone, and other major urban areas.

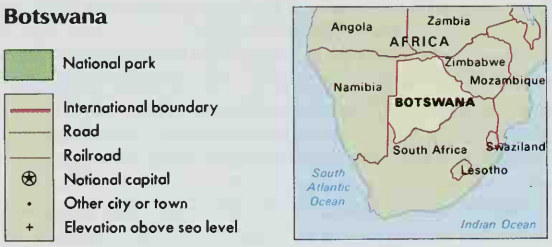
History. In prehistoric times, the San lived in what became Botswana. Sometime between A.D. 1 and A.D. 1000, the Tswana came to the area from the north. They settled in the fertile eastern lands and pushed the San into the Kalahari region.

During the 1800's, the Tswana fought with rival black African groups and with white settlers from what is now South Africa. The Tswana sought European support against their enemies. In the late 1800's, Britain brought the area that is now Botswana under its protection. In 1895, this area became known as the Bechuanaland Protectorate. Britain governed the area until the 1960's. The South African government asked Britain several times to transfer the protectorate to South Africa, but the British refused to do so.

The Bechuanaland Protectorate gained independence as the Republic of Botswana on Sept. 30, 1966. Seretse Khama became the nation's first president.

Botswana's economy has grown rapidly since independence. South Africa has provided the country with technology and other assistance. In addition, Botswana has sought closer ties with Angola, Mozambique, Tanzania, and Zambia. An all-weather road from southern Botswana to Zambia was completed in 1977.

The National Assembly reelected President Khama in 1969, 1974, and 1979. Khama died in 1980. The National Assembly elected Quett Ketumile Joni Masire to succeed Khama as president. It reelected Masire, now known as Sir Ketumile Masire, in 1984, 1989, and 1994. Masire resigned as president in 1998. Vice President Festus Mogae succeeded him. Mogae remained president following elections held in 1999. Louis A. Picard



WORLD BOOK maps

See also **Gaborone**; **Kalahari Desert**.

Böttger, *BAYT guhr,* **Johann Friedrich,** *YOH hahn FREE drihkh* (1682-1719), a German chemist, was the first European to produce porcelain (see **Porcelain**). The process had been a mystery for hundreds of years after Chinese porcelain was first brought to Europe. Böttger produced porcelain in 1708 and made a suitable glaze for it in 1709. His genius in ceramic technology had much to do with many of the things we enjoy today. For example, porcelains in bathrooms and porcelain insulation in spark plugs are both results of Böttger's discovery. Böttger was born in Schleiz, near Plauen, Germany. See also **Dresden china.** William C. Gates, Jr.

Botticelli, *BAHT ih CHEHL ee,* **Sandro,** *SAHN droh* (1444?-1510), was an Italian Renaissance painter who lived and worked in Florence. His pictures are distinctive for their clear, rhythmic line, delicate color, lavish decoration, and poetic feeling. He did not share the interest of his fellow Florentines in nature and science. As a result, he did not try to represent space according to

Tempera painting on wood panel (1477-1478); Uffizi Gallery, Florence, Italy (SCALA/Art Resource)

Botticelli's *La Primavera (Springtime)* is a complex symbolic painting based on classical mythology. The central female figure represents spring. The god Cupid flies above her. The god Mercury appears at the far left, next to the dancing three Graces. At the far right, the wind god Zephyr pursues a nymph next to the goddess Flora, who scatters flowers. The setting is an orange grove.

the laws of perspective, or the human body and its movements according to the laws of anatomy.

Botticelli's work is of two kinds. In one, he showed worldly splendor, complex moral allegory, and beautiful mythological subjects. One of his most famous mythological pictures, *Birth of Venus,* is reproduced in the **Painting** article.

His other kind of work shows more restrained, serious feeling. Examples are his illustrations of Dante's *Divine Comedy* and his religious pictures. Even in his early years, he painted several sweet, but grave, Madonnas. In the late 1490's, in Florence, Botticelli became so moved by Savonarola's preaching against worldliness that he burned some of his own nonreligious pictures and painted only religious ones afterward.

Botticelli was born Allesandro Filipepi. He studied with Fra Filippo Lippi and was greatly influenced by the sculptor Andrea del Verrocchio and the painter and sculptor Antonio del Pollaiuolo. Vernon Hyde Minor

See also **Graces** (picture); **Lippi, Filippo; Painting** (The 1400's); **Savonarola, Girolamo**.

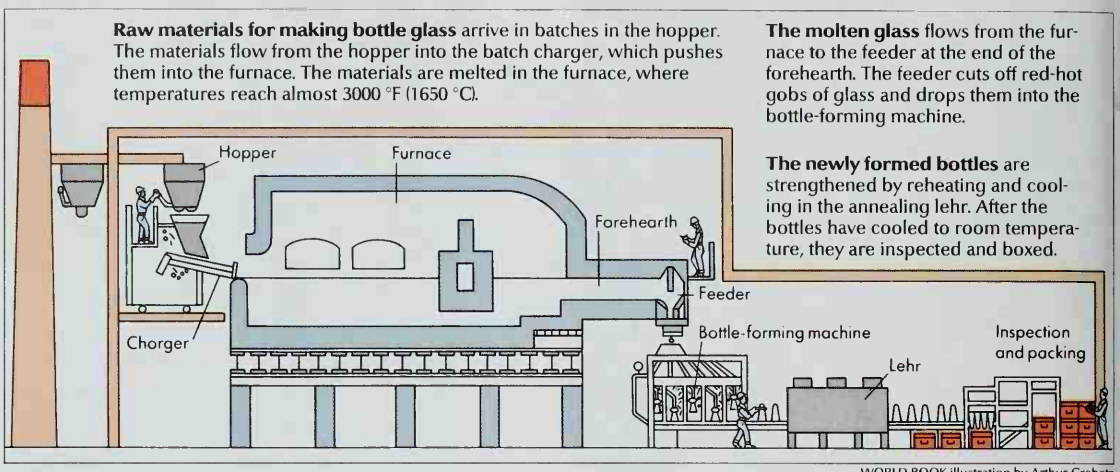
Bottle is a container for holding liquids. Most bottles are made of glass or plastic. Other materials used to make bottles include earthenware and such metals as steel and aluminum. Bottles have either narrow or wide mouths that are closed with corks, glass stoppers, or plastic or metal covers.

The United States leads the world in the manufacture of glass and plastic containers. It produces about 46 billion glass containers and about 11 billion plastic containers each year for use with beverages, cosmetics, foods, and pharmaceuticals.

Almost all bottles are made by automatic machinery. In glass-bottle making, an automatic feeder separates a stream of *molten* (melted) glass into individual gobs. Each red-hot gob is sent to a mold and shaped into a *parison.* The parison looks like a short bottle with thick sides. The machine transfers the parison to the final mold. There air is pumped into the parison, expanding the hot glass into the exact shape of the mold. This expanding procedure is called *blowing.*

Materials used to make plastic bottles include polyethylene, polypropylene, and polyvinyl chloride. There are three different processes used for producing plastic bottles: (1) extrusion blow molding, (2) injection blow molding, and (3) injection-stretch blow molding. These processes resemble the glass-bottle making process. In extrusion blow molding, however, the parisons are tube-shaped. In injection blow molding, the molten plastic is injected through a small hole to form the parisons. In injection-stretch blow molding, the plastic is stretched—in most cases, by a metal rod—as it is blown into a mold. Large soft drink containers made of *polyethylene terephalate* (PET) are made by injection-stretch blow molding. This process changes the chemistry of the plastic so the PET containers will keep the gases

How bottles are made



WORLD BOOK illustration by Arthur Grebetz

used in the carbonation of soft drinks from escaping.

People discovered how to form glass containers about 2,000 years ago. They gathered molten glass on the ends of hollow iron pipes and expanded the glass by blowing through the pipes. Later, people found that molten glass could be blown into molds. In the 1930's, Independent Section (I.S.) glass-bottle making machines were introduced. Today, improved models of the I.S. machines produce almost all the glass bottles made.

The first plastics blow molding machines were patented in the early 1940's. Polyethylene squeeze bottles soon became the first plastic bottle products.

In the early 1970's, some people argued that glass bottles added to environmental pollution. Recycling centers were set up so people could return bottles for reuse in other bottles. Most recycled plastic bottles are used to manufacture lower quality plastics than those used to make bottles. Peter J. Vergano

See also **Glass**.

Bottle tree is an Australian tree whose trunk looks like a round bottle. Bottle trees thrive in dry areas of northeastern Australia. Bottle trees grow as tall as 60 feet (18 meters). But the main part of the trunk is short and thick. It extends from 10 to 20 feet (3 to 6 meters) above the ground. Then, just below the branches, the trunk gradually narrows, giving the tree its bottlelike shape. Many trunks measure about 6 feet (1.8 meters) in diameter.

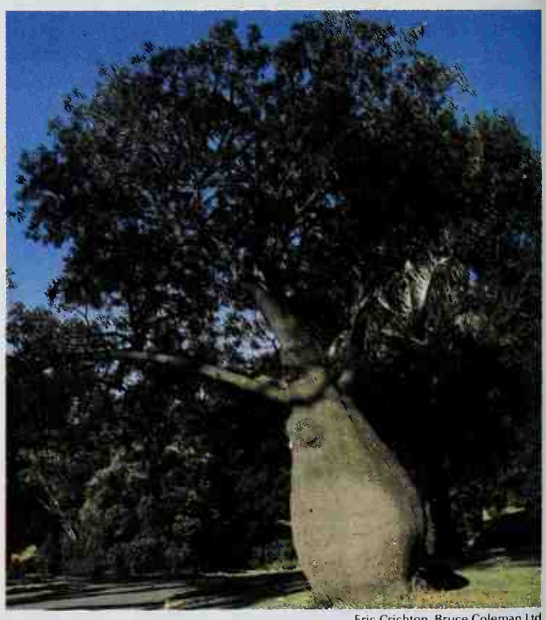
Bottle trees can live in a dry climate because they store water under their bark. The inside of the trunk consists of a spongy material that contains jellylike sap. The tree's leaves form clusters of narrow leaflets. The leaflets grow 2 to 4 inches (5 to 10 centimeters) long. The baobab tree of Africa is related to—and is sometimes called—the bottle tree (see **Baobab**). William C. Burger

Scientific classification. The bottle tree belongs to the sterculia family, Sterculiaceae. It is *Brachychiton rupestris*.

Botulism, *BAHCH uh lihz uhm,* is a kind of food poisoning that affects the nervous system and results from improperly canned or preserved food. It is caused by a *toxin* (poison) produced by bacteria called *Clostridium botulinum*. These bacteria live mainly in the soil and grow only where there is no oxygen. They produce cells called *spores* that can survive the temperature of boiling water (212 °F, or 100 °C) for hours. The spores may live in improperly canned food. If the food lacks oxygen, the spores become active bacteria and secrete botulinum toxin into the food. Modern commercial canning methods have made botulism rare in the United States.

Botulinum toxin is absorbed by the intestine and carried to the nerves, where it may cause paralysis. Unless victims are kept breathing by artificial means, they may die of suffocation because the muscles used in breathing are paralyzed. An *antitoxin* (drug that counteract poisons) has been developed for botulinum toxin. Botulism antitoxin can reduce the severity of the symptoms.

A type of botulism called *infant botulism* affects babies. Unlike botulism from canned foods, which results from eating foods contaminated with botulinum toxins,



Eric Crichton, Bruce Coleman Ltd.

The bottle tree is named for its trunk, which resembles a bottle. The tree grows in dry regions of northeastern Australia.

infant botulism results from swallowing the botulinum spores themselves. The spores produce the toxin within the baby's intestines. Botulinum spores are found in honey and many other raw agricultural products. By the age of 1 year, babies have developed bacteria in their intestines that stop the growth of botulinum organisms.

Doctors use botulinum toxin to treat conditions caused by abnormal muscle spasms, such as tension headaches. Injecting a tiny amount of toxin into the affected muscles causes them to relax. The toxin, marketed as Botox, is also used to relax facial muscles and thus improve the appearance of wrinkled skin. Scientists are investigating other uses of the toxin. Melanie Johns Cupp

Bouchard, *boo SHAHR,* **Lucien,** *loo SYEHN* (1938-), served as the leader of the Parti Québécois, Quebec's powerful separatist party, and the premier of Quebec from 1996 to 2001. From 1991 to 1996, he had served as head of the Bloc Québécois. Under Bouchard's leadership, the Bloc Québécois became the second largest political party in the Canadian House of Commons in 1993. Bouchard had helped form the Bloc Québécois in 1990, bringing together Quebecers from other parties who shared the goal of independence for Quebec.

Bouchard was born in Saint-Coeur-de-Marie, near Alma, Quebec. He received a law degree from Laval University. In the early 1970's, he joined the Parti Québécois. Bouchard served as Canada's ambassador to France from 1985 to 1988. In 1988, he became a member of the Cabinet of Progressive Conservative Prime Minister Brian Mulroney. Later that year, he joined the Progressive Conservative Party and won a seat in the House of Commons. Bouchard resigned from the Cabinet and the Progressive Conservative Party in 1990. Graham Fraser

Boucher, *boo SHAY,* **François,** *frahn SWAH* (1703-1770), was a leading painter in France during the 1700's. He perfected the elegant, decorative style called *Rococo.* The bright colors and fluid touch that characterize this style are found in Boucher's most famous paintings. These works portray the loves of the Greek and Roman gods and goddesses. The Rococo style also appears in his portraits, landscapes, book illustrations, and designs for tapestries and theatrical sets.

Boucher was born in Paris and studied there and in Rome. He became the favorite painter of Madame de Pompadour, mistress of King Louis XV. Through her influence, he received commissions for some of his major decorative works. In 1765, he was appointed First Painter to the King and Director of the French Academy. This gave Boucher virtual control of all the official French art of the day. His influence is evident in the work of his best pupil, Jean Honoré Fragonard. Eric M. Zafran

See also **Rococo.**

Boucicault, *BOO sih koh,* **Dion,** *DY ahn* (1820?-1890), was an Irish American playwright, actor, and theater manager. His plays combine melodrama, thrilling spectacle, and lifelike scenes and characters. As a manager, he was credited with starting the movement toward American touring companies in 1860.

Boucicault was born in Dublin, Ireland. Beginning with *London Assurance* (1841), he wrote about 125 plays, many of them adaptations. One of his most successful was *Rip Van Winkle* (1865), written with actor Joseph Jefferson. *The Colleen Bawn* (1860) was the first of his many plays depicting Irish rural life. Frederick C. Wilkins

Boudicca. See Boadicea.

Bougainville, *BOO guhn VIHL,* is the largest of the Solomon Islands. It lies north of Australia and is part of the nation of Papua New Guinea (see **Papua New Guinea** [map]). Bougainville, Buka, and smaller islands make up the North Solomons Province. The province covers about 3,600 square miles (9,300 square kilometers). Much of Bougainville is mountainous. Its main products include cocoa, *copra* (dried coconut meat), and timber. It also has copper and gold deposits. About 200,000 people, mostly Melanesians, live on the island.

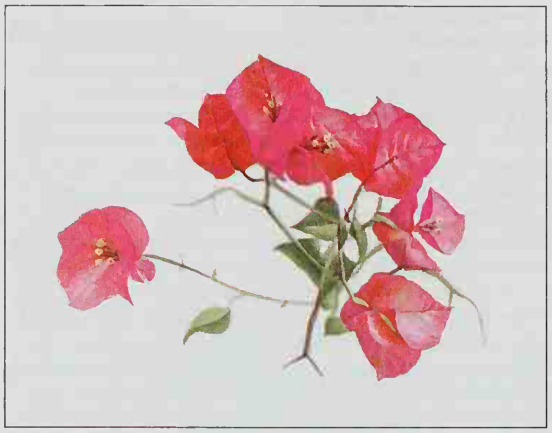
The island is named after Louis-Antoine de Bougainville, a French navigator who mapped the east coast of the island in 1768. In 1886, the island came under German administration. In 1914, Australia gained control of Bougainville. In 1942, during World War II, Japan captured the island. After Japan's defeat in 1945, Bougainville was returned to Australia.

In 1975, Papua New Guinea gained independence from Australia. Bougainville became part of the new nation. However, many Bougainvilleans want Bougainville to be independent. Conflicts over mining and land rights that began in 1988 soon grew into a fight for independence. Rebel leaders and the Papua New Guinea government signed a cease-fire agreement in 1998 and a peace accord in 2001. The accord grants Bougainville more *autonomy* (self-rule) and authorizes a referendum to eventually be held on independence. Hank Nelson

Bougainvillea, *BOO guhn VIHL ee uh,* is the name of a group of South American shrubs and climbing vines. They grow to a height of 10 feet (3 meters) or more. They have small flowers that are enclosed by large, colorful *bracts* (modified leaves). These bracts may be red, purple, pink, orange, or pale yellow. Bougainvillea were

The Interrupted Sleep (1750), an oil painting on canvas; the Metropolitan Museum of Art, New York City, the Jules Bache Collection, 1949

A Boucher painting shows two young people in a picturesque landscape setting. It reflects Boucher's use of charming, romantic themes and his elegant, richly colored Rococo style.



WORLD BOOK illustration by Robert Hynes

A bougainvillea is a tropical South American shrub. The plant has colorful, large modified leaves called *bracts.*

named for the French explorer Louis Antoine de Bougainville. They are often grown as porch climbers in the South and in California, and for hedges in South America. They must be kept in greenhouses in colder climates. They are raised from cuttings. Daniel F. Austin

Scientific classification. Bougainvillea belong to the four-o'clock family, Nyctaginaceae. They make up the genus *Bougainvillea.*

Boulder Dam. See Hoover Dam.

Boulding, Kenneth Ewart (1910-1993), was an American economist whose writings have influenced many scholars. He called for a unified social science for the purpose of studying people in relationship to others. This science would integrate economics with political science, sociology, and other fields of study.

Boulding was born in Liverpool, England, and graduated from Oxford University. He became a United States citizen in 1948. Boulding taught at several schools, including Colgate and Edinburgh universities, Iowa State College (now Iowa State University), and the University of Michigan. He joined the faculty of the University of Colorado in 1967. Boulding wrote more than 15 books, including *A Reconstruction of Economics* (1950) and *Economics as a Science* (1970). Barry W. Poulson

Boulez, *boo LEHZ,* **Pierre** (1925-), is a leading *avant-garde* (experimental) composer. He is also an important conductor and has presented the first performances of many works by living composers. From 1971 to 1977, Boulez was musical director of the New York Philharmonic. From 1979 to 1992, he served as president of IRCAM, an electronic music and research center and performance institute in Paris.

In many compositions, Boulez uses dynamic rhythmic structures and an orchestration that emphasizes the interplay of unusual *timbres* (instrumental colors). While notable for its freedom and individuality, his music also reflects the influence of composers Arnold Schoenberg and Anton Webern. Another important influence on Boulez is the rhythmically original music of the modern composers Olivier Messiaen and Igor Stravinsky.

In much of his music, Boulez permits the performers considerable freedom. For example, in Boulez's Piano Sonata No. 3 (1957), the pianist may choose the order in which he or she progresses through the composition. Boulez also composes electronic music.

Boulez was born in Montbrison, France, near Clermont-Ferrand. His articles and essays on music were published in *Orientations* (1986). Stephen Jaffe

Bourassa, *boo rah SAH,* **Henri,** *ahn REE* (1868-1952), was a French-Canadian journalist and political leader. He served in the Canadian House of Commons from 1896 to 1899, from 1900 to 1907, and from 1925 to 1935. He was a member of the Quebec legislature from 1908 to 1912. He founded *Le Devoir,* an influential Montreal newspaper, in 1910. He edited the paper until 1932.

Bourassa fought throughout his life against the harmful effects of materialism and industrialization. He also fought for the equality of the French and English languages and cultures in Canada and for greater Canadian independence from Britain. He opposed sending Canadian soldiers to fight for the British in the Boer War (1899-1902) or in World War I (1914-1918). Bourassa was born in Montreal. D. Peter MacLeod

Bourbon, *BOOR buhn,* was the name of a French royal family, some of whose members ruled in France, Spain, Naples, and Sicily. The family took its name from Bourbon l'Archambault, a small town in central France. In France, the Bourbon rulers formed the third and final branch of the great Capetian line of French kings.

In France. Bourbon kings reigned from 1589 to 1792 and from 1814 to 1848. The Bourbons ruled during the period of France's greatest influence on European politics and culture. They established the idea of *absolute monarchy,* or unlimited rule, especially during the reign of Louis XIV (1643-1715). During Bourbon rule, French became the diplomatic language of Europe. The Bourbons also began France's overseas empire.

Henry IV became the first Bourbon king in 1589. He was a descendant of Robert de Clermont, a son of King Louis IX. Louis IX had ruled France from 1226 to 1270. Henry's descendants Louis XIII, XIV, XV, and XVI ruled until 1792, when Louis XVI lost the throne and was executed during the French Revolution. Louis XVI's brother, Louis XVIII, became king first in 1814, after Napoleon fell from power, and again in 1815, after Napoleon's unsuccessful return. Louis XVIII ruled until 1824 when Louis XVI's youngest brother, Charles X, succeeded him. Charles X was forced from his throne in 1830, and Louis Philippe became king. Louis Philippe was descended from Philippe d'Orléans, the brother of Louis XIV. Louis Philippe lost the French throne in the Revolution of 1848. Since that time, Bourbon and Bourbon-Orléans candidates have asserted claims to the throne.

In Spain, Bourbon kings began to rule in 1700, after Charles II of Spain named a grandson of France's Louis XIV and of Charles's half sister Maria Theresa to succeed him as Philip V. This alliance between the two monarchies strongly influenced European power politics, and also brought French administrative practices into Spain. The Spanish Bourbon rulers included Philip V, Louis I, Ferdinand VI, Charles III, Charles IV, Ferdinand VII, Isabella II, Alfonso XII, and Alfonso XIII. The reign of Alfonso XIII ended in 1931 when Spain became a republic. In 1975, Spain became a monarchy again. Juan Carlos I, grandson of Alfonso XIII, became king.

In Naples and Sicily, Charles IV, son of Philip V of Spain, was the first Bourbon king, from 1734 until 1759

when he became King Charles III of Spain. His reign, one of the few successful "enlightened despotisms," was a period of political reform and cultural advancement. In 1759 at the age of 8, Charles's third son became King Ferdinand IV of Naples and Ferdinand III of Sicily. He was forced from the throne of Naples by Napoleon from 1798 to 1799 and again from 1806 to 1815. In 1816, he formally united Naples and Sicily as the Kingdom of the Two Sicilies, with himself as King Ferdinand I. He ruled until 1825. The other Bourbon rulers of the kingdom included Francis I, Ferdinand II, and Francis II. Francis II was forced from his throne in 1860. In 1861, the Two Sicilies became a part of the kingdom of Italy under King Victor Emmanuel. Donald A. Bailey

Related articles in *World Book* include:

Alfonso XIII	Charles X (of France)	Juan Carlos I	Louis XVII
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Charles III (of Spain)	Henry IV (of France)	Louis XIV	Philip V (of Spain)
		Louis XV	Salic law
		Louis XVI	

Bourguiba, *boor GEE buh,* **Habib,** *HAH beeb* (1903-2000), was president of Tunisia from 1957 to 1987. An important Arab leader, he led Tunisia's struggle for independence from France. Bourguiba was elected president in 1957, after Tunisia won independence. He was reelected in 1959, 1964, and 1969. In 1975, Bourguiba was named president for life. But in 1987, he was removed from office by Zine el-Abidine Ben Ali, the country's prime minister. Bourguiba's age and poor health made him incapable of handling the office. As president of Tunisia, Bourguiba improved the courts and gave women the right to vote. He opposed Communism and supported moderate socialism. He was born on Aug. 3, 1903, in Al Munastir, Tunisia. William I. Shorrock

See also Tunisia (History).

Bourke-White, Margaret (1904-1971), was an American news photographer. Bourke-White helped refine the use of *photo essays* in photojournalism. Photo essays use a series of photographs—instead of just one picture—to portray a subject.

Bourke-White was born on June 14, 1904, in New York City. In 1929, she went to work as a photographer for *Fortune* magazine, where she specialized in pictures of factories, machinery, and industrial workers. In 1936, she became one of the first staff photographers of *Life* magazine. During World War II (1939-1945), she photographed combat scenes in Europe. She also recorded the shocking condition of prisoners in Nazi concentration camps. Her other famous assignments included India's struggle for independence from Britain, the Korean War, and labor conditions in South Africa.

Bourke-White published a number of picture books, including *Eyes on Russia* (1931), *North of the Danube* (1939), *They Called It 'Purple Heart Valley'* (1944), and *Halfway to Freedom* (1949). *You Have Seen Their Faces* (1937), a joint effort of Bourke-White and the American novelist Erskine Caldwell, showed the misery of sharecroppers in the Southern United States. Richard Rudisill

Boutros-Ghali, *BOO trohs GAH lih,* **Boutros,** *BOO trohs* (1922-), a diplomat from Egypt, was secretary-general of the United Nations (UN) from 1992 through 1996. He replaced Javier Pérez de Cuéllar of Peru, who had held the office from 1982 to 1991. Boutros-Ghali became the first secretary-general from Africa.

Boutros-Ghali was born on Nov. 14, 1922, in Cairo. He received a law degree from Cairo University in 1946 and a Ph.D. in international law from the University of Paris in 1949. He was a professor of international law and international relations at Cairo University from 1949 to 1977.

Boutros-Ghali's career as a government official and diplomat began in 1977, when he was appointed Egypt's minister of state for foreign affairs. He became deputy prime minister for foreign affairs in 1991. In these posts, Boutros-Ghali led Egyptian delegations to many international conferences and meetings, including those of the UN General Assembly. Boutros-Ghali has written many books on political science and international affairs. Michael C. Hudson

See also United Nations (picture).

Bouvier des Flandres, *boo VYAY day FLAHN druh,* is a breed of dog that originated in Belgium. Its name means *Flemish cowherd* in French. The bouvier is a powerfully built, energetic dog. Its rough coat ranges in color from fawn to black, and there may be a star-shaped patch of white hair on the chest. Owners often *crop* (trim) its ears so they stand erect, and *dock* (shorten) its tail. The bouvier stands from 23 to 27 inches (58 to 69 centimeters) high.

Critically reviewed by the North American Bouvier des Flandres Club

© Kent & Donna Dannen

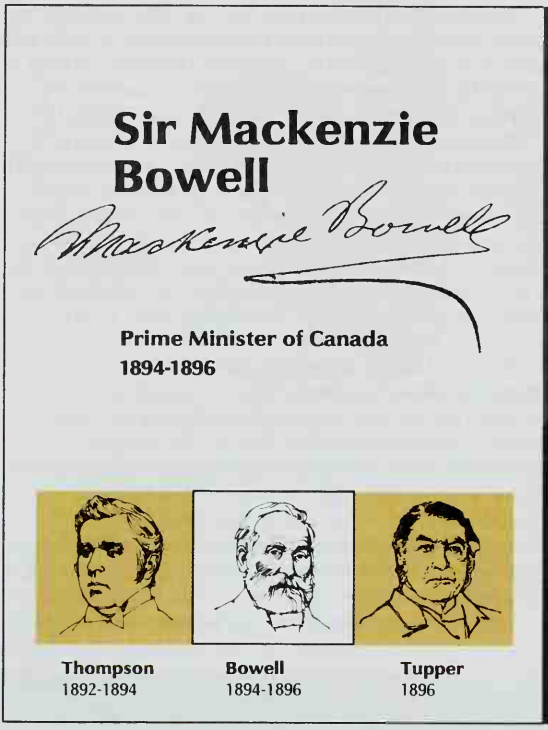
The bouvier des Flandres makes an alert watchdog.

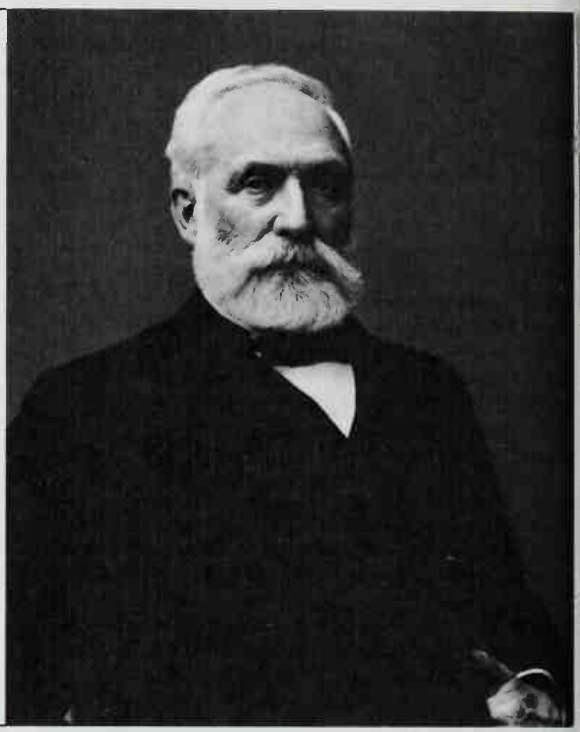
Bow and arrow. See Archery.

Bowditch, *BOW dihch,* **Nathaniel** (1773-1838), an American mathematician and astronomer, is known for his extensive revision of *The Practical Navigator,* which he renamed *The New American Practical Navigator* in 1802. This book explains the principles of navigation and the most practical methods of applying them. The book still is called "the seaman's Bible."

Bowditch also wrote many scientific papers. He translated and added clarifying comments to the four-volume work, *Celestial Mechanics* (1829-1839), by Pierre Simon de Laplace. Bowditch's translation of this work was widely used in English-speaking countries in the study of the movements of the stars and planets.

Bowditch became a fellow of the American Academy of Arts and Sciences in 1799 and served as its president from 1829 until his death. He was the first American elected to the Royal Astronomical Society. Bowditch was born on March 26, 1773, in Salem, Massachusetts, the son of a shipmaster. He left school at age 10 and later worked as a ship's master. Donald K. Yeomans





The Public Archives of Canada, Ottawa

Bowell, *BOH uhl,* **Sir Mackenzie,** *muh KEHN zee* (1823-1917), served as prime minister of Canada from December 1894 to April 1896. He succeeded Sir John S. D. Thompson, who had died in office.

Bowell, a Conservative, accomplished little as prime minister. He lost the support of his party because he failed to take action on the Manitoba school dispute. This disagreement involved the right of Roman Catholics in Manitoba to have their own school system. Bowell finally resigned because of dissatisfaction with his leadership.

Bowell was a newspaper owner and small businessman before he entered politics. He also served in the Canadian House of Commons and Senate and held various Cabinet positions. As a political leader, Bowell was weak, fussy, and conceited. He avoided making up his mind on many questions and often reversed his decisions. As a result, many politicians distrusted him.

Early life

Mackenzie Bowell was born on Dec. 27, 1823, in Rickinghall, England, near Bury St. Edmunds. His father, John Bowell, was a carpenter. In 1833, Mackenzie's parents moved to Canada and settled in Belleville, Upper Canada (present-day Ontario).

Mackenzie did not have a formal education. At the age of 11, he began working as a printer's apprentice for a Belleville newspaper, the *Intelligencer.* By 1860, he had become owner and editor of the paper.

Bowell was chairman of the Belleville school board and an officer of several local business firms, including hardware, insurance, and railroad companies. He also was a leader of the Orange Order, an organization that worked to increase the influence of Protestants in Canadian politics and society. In 1847, he married Harriet Louise Moore of Belleville. They had nine children.

Early political career

In 1867, Bowell won election to the Canadian House of Commons from Hastings North. His political strength lay partly in his newspaper, which strongly supported the Conservative Party. But Bowell's appeal also came from his leadership in the Orange Order, which had great influence in Canadian politics at the time.

Sir John A. Macdonald, the first prime minister of Canada, appointed Bowell minister of customs in 1878. After Macdonald's death in 1891, Bowell became minister of militia in the administration of Sir John J. C. Abbott. In 1892, he was named minister of trade and commerce by Abbott's successor, Sir John S. D. Thompson. Thompson appointed Bowell to the Senate that same year, and Bowell became Government leader of that body.

Thompson died suddenly in London on Dec. 12, 1894. The governor general of Canada, the Marquis of Aberdeen and Temair, had to choose a replacement. He consulted Conservative leaders and then chose Bowell, who had served as acting prime minister in Thompson's absence. Some politicians opposed the choice, believing that Bowell lacked the qualities for leadership. But others felt that no other Conservative could draw general support. Bowell became prime minister on Dec. 21, 1894. Queen Victoria knighted him on Jan. 1, 1895.

Prime minister

The Manitoba school dispute was the chief problem that faced the Bowell Government. In 1890, the

Manitoba legislature had abolished the province's separate system of schools for Roman Catholics. Manitoba Catholics fought the decision in the courts and lost, and then they appealed to the Canadian government. The government stalled, questioning its authority to reject the Manitoba decision. In January 1895, the British Privy Council ruled that the Canadian government had the power to act on the school issue.

The Canadian government ordered Manitoba to restore the separate Catholic schools, but the province refused to do so. The dispute split the Conservative Party. Most Catholics demanded that the national government pass legislation to restore the schools, but most Protestants strongly opposed such legislation. Bowell did not take a firm stand on the issue. He kept delaying any action, hoping that the province would agree to a compromise and make federal legislation unnecessary. However, the government of Manitoba refused to change its position.

The Newfoundland question. Bowell worked to bring Newfoundland into the Dominion of Canada in 1895. The colony had economic problems and hoped that Canada would take over its debts. But Bowell's Government and Newfoundland's leaders could not reach a financial agreement. Newfoundland received money from private sources and dropped its plan to join the Dominion. It finally became a province in 1949.

Cabinet crisis and resignation. Bowell gradually lost the support of his Cabinet, largely because of his weakness in dealing with the Manitoba school question. By the end of 1895, many Cabinet members wanted to replace him. They believed that Sir Charles Tupper could unite the Conservative Party and solve the school question. Tupper, the Canadian High Commissioner in London, had served in the Cabinets of Prime Minister Macdonald. Seven members of Bowell's Cabinet resigned in January 1896. Bowell tried to replace them, but no Conservative leader would join his Cabinet.

An agreement was finally reached, and Bowell continued as prime minister until the session of Parliament ended. Tupper became leader of the House of Commons and the actual head of the Government. Six of the Cabinet members who had resigned returned to office. In February, Tupper introduced a bill in the House to restore the Roman Catholic schools in Manitoba. But a long debate kept the legislation from coming to a vote before the session ended in April. Bowell resigned on April 27, 1896. Tupper succeeded him as prime minister.

Later years

Bowell remained in the Senate following his resignation as prime minister. He became Opposition leader in the Senate after the Liberals won the elections of June 1896. Also in 1896, Bowell resumed his work on the *Intelligencer,* which he had given up after accepting his first Cabinet appointment. He retired from politics in 1906 and died in Belleville on Dec. 10, 1917. P. B. Waite

See also **Prime minister of Canada.**

Bowen, Elizabeth (1899-1973), was an Anglo-Irish author of novels and short stories about the problem of personal relationships in the modern world. Her books deal especially with the upper-middle class, and often focus on how the demands and values of others affect the individual. Much of the action in her novels involves internal conflict. But Bowen was also expert at describing the physical settings in her fiction and the social attitudes of her characters. *The House in Paris* (1935) explores the complex emotional relationships surrounding a young English boy in Paris. *The Death of the Heart* (1938), set in London, examines a girl's growth to maturity and her understanding of the limitations of the people she knows. *The Heat of the Day* (1949) is a tightly written story about a wartime love affair.

Elizabeth Dorothea Cole Bowen was born in Dublin. Three books of her writings were published after her death. They were *The Collected Stories of Elizabeth Bowen* (1981) and two collections of her nonfiction, *Pictures and Conversations* (1975) and *The Mulberry Tree* (1987). Michael Seidel

Bowerbird is the name of 18 species of birds that live in Australia, New Guinea, and neighboring islands. The birds are named for their *bowers.* These small chambers or runways in the forest are built by the males and are an important part of the courtship ritual. The males use these structures as display areas where they bow and dance to court their mates. The bowers are built of such materials as grass, moss, twigs, and vines. Some males construct their bowers by heaping up twigs around the base of a bush. Others pile sticks between the trunks of two trees and use vines to form a roof.

The birds decorate their bowers with bright objects such as feathers, berries, shells, and orchids and other flowers. Often, these bright decorations are laid on beds of green moss at the entrance to the bower. The decorations are cleared away from the bower as soon as they fade or wither.

Bowerbirds are $8\frac{1}{2}$ to 15 inches (21 to 38 centimeters) long. Some have bright plumage, but others are rather inconspicuous. Bowerbirds build simple nests in trees. They feed chiefly on fruit.

Scientific classification. Bowerbirds belong to the bowerbird family, Ptilonorhynchidae. The satin bowerbird is the best-known species. It is *Ptilonorhynchus violaceus.*

Fred J. Alsop III

E. R. Degginger

The satin bowerbird has a glossy, blue-black color and china-blue eyes. Male bowerbirds build elaborate structures called *bowers* where they bow and dance to court their mates.

Tom McHugh, Photo Researchers

The bowfin is a large freshwater fish.

Bowfin, *BOH fihn,* is a large freshwater fish that lives in eastern North America. It is a "living fossil" because it closely resembles fish that lived more than 200 million years ago. Its closest living relative is the gar (see **Gar**).

The bowfin lives in quiet, weedy waters. The male makes a nest and protects the eggs. After hatching, the young attach themselves to vegetation for seven to nine days using a special adhesive organ on the tip of the snout. The male bowfin guards the young until they are about 4 inches (10 centimeters) long. Bowfins eat mainly other fish, frogs, and crayfish. They may live as long as 30 years in captivity. The bowfin is sometimes called *dogfish.* Tomio Iwamoto

Scientific classification. The bowfin is the only living member of the bowfin family, Amiidae. Its scientific name is *Amia calva.*

Bowhead whale is a large whale that lives in the Arctic Ocean. Male bowheads grow up to about 60 feet (18 meters) in length, and females are slightly larger. The bowhead whale is black with patches of white on the chin. Some bowhead whales have white patches on the belly, and whitish rings around the flippers or tail. Like the closely related black right whale, the bowhead has a flat, wide, finless back. Bowhead whales were called *Greenland right whales* by early American whalers.

A bowhead whale has a deeply curved mouth. Long plates called *baleen* hang from the upper jaw. The baleen strain food, mainly tiny shellfish called *copepods,* from the water. When feeding, bowhead whales sometimes seem to work in a coordinated effort to corral prey. Such apparent cooperation and observations of bowhead whales playing together with logs and other objects in the water have led scientists to speculate that bowheads are complex social mammals.

Bowhead whales were heavily hunted from the 1700's to the early 1900's. Today, the bowhead is an endangered species and protected by international restrictions. However, Inuit in Alaska legally hunt a small number of bowhead whales each year. Bernd Würsig

Scientific classification. The bowhead whale belongs to family Balaenidae, suborder Mysticeti, order Cetacea. Its scientific name is *Balaena mysticetus.*

See also **Whale** (picture: Some kinds of whales).

Bowie, *BOH ee* or *BOO ee,* **James** (1796?-1836), became known for his role in the Texas Revolution. He also was the reputed inventor of a hunting knife called the bowie knife.

Bowie was a figure of the frontier whose career gave rise to legends which now make it difficult for historians to sift facts from folklore. Scholars disagree on both his birthdate and birthplace, but he was probably born in 1796 in Kentucky. The Bowie family moved westward with the frontier. Bowie reached San Antonio, Texas, about 1828, and became a Mexican citizen within two years. He became a prospector and a land speculator. He is said to have engaged in the smuggling of slaves along the Texas-Louisiana border. There is also a hint that he became associated with the Laffite pirates (see **Laffite, Jean**). It is known that he lived the rough life of the border. He was injured in a gunfight and engaged in numerous battles with the Indians.

Bowie is probably remembered mostly for his contribution to the manufacture of a dangerously effective hunting knife. He is said to have introduced the long *bolster,* a perpendicular piece adjoining the handle, to a hunting knife to make it an effective defensive weapon. It is said that he added the bolster because he lost his grip on a butcher knife in an Indian fight.

Detail of a mural (1935-1936) by Eugene Savage; Texas Hall of Fame, Dallas (Dallas Historical Society)

James Bowie, shown here on the cot, was ill during the siege of the Alamo in 1836. Bowie, a fighter in the Texas Revolution, died along with the rest of the Alamo's defenders.

Bowie fought in the Texas Revolution (see **Texas** [History]). He became known for fighting with the Texas resistance movement at Nacogdoches, Texas, in 1832, and in other early struggles in the revolt against Mexico. He became a colonel in 1835 in a campaign that cleared San Antonio, Texas, of the Mexican Army. He later fought with William Travis, Davy Crockett, and the force that fell in the Alamo (see **Alamo**). Michael A. Lofaro

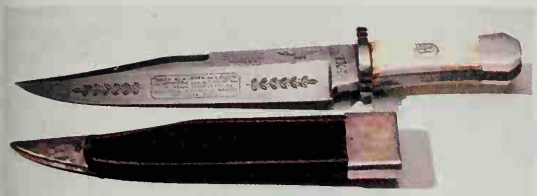
Additional resources

Davis, William C. *Three Roads to the Alamo: The Lives and Fortunes of David Crockett, James Bowie, and William Barret Travis.* HarperCollins, 1998.

Hopewell, Clifford. *James Bowie: Texas Fighting Man.* Eakin, 1994.

Bowie knife, *BOH ee* or *BOO ee,* was a popular hunting tool and weapon of the American frontier. It consisted of a short handle with a hand guard and a long, wide single-edged blade. The end of the blade curved to a sharp point. The blade was from 9 to 15 inches (23 to 38 centimeters) long and from 1 $\frac{1}{2}$ to 2 inches (3.8 to 5 centimeters) wide.

The first bowie knife is said to have been made in 1830 by James Black, an Arkansas blacksmith. It was an improved version of a knife owned by the frontiersman James Bowie. Bowie's use of the knife popularized the design, and many imitations of the knife appeared. Many soldiers marched off with "bowies" to fight in the



David R. Frazier Photolibrary

A bowie knife served as a hunting tool and a weapon. It had a curved, single-edged blade and was carried in a sheath. The bowie knife shown above dates back to the Civil War.

Civil War (1861-1865). However, interest in the knife declined soon after the war. Bowie-style knives made today are chiefly collector's items or hunting knives.

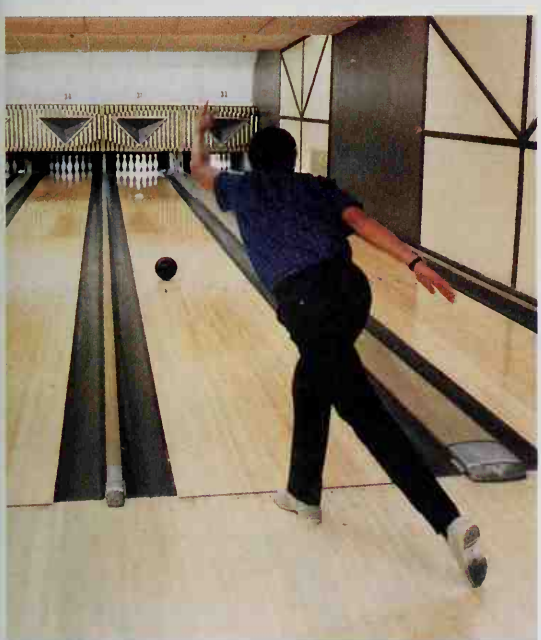
Walter J. Karcheski, Jr.

See also **Bowie, James.**

Bowling is one of the oldest and most popular indoor sports. More Americans compete in bowling than in any other sport. Every year in the United States, about 82 million people roll balls down gleaming wooden lanes to try to knock down the 10 pins.

Bowling is becoming increasingly popular in other countries as well, especially in Canada, Japan, and the Latin-American nations. In addition to tenpin bowling, many people enjoy other forms of the sport, including boccie, candlepins, duckpins, fivepins, lawn bowling, and ninepins.

Until the 1950's, bowling was considered a sport for bowlers only. But today, major tournaments attract thousands of spectators. Bowling tournaments also rank among the most popular sports shows on television.



WORLD BOOK photo by Dan Miller

Bowling is a popular form of recreation and an exciting sport. Every year, millions of people visit bowling alleys and roll balls to try to knock down the 10 pins.

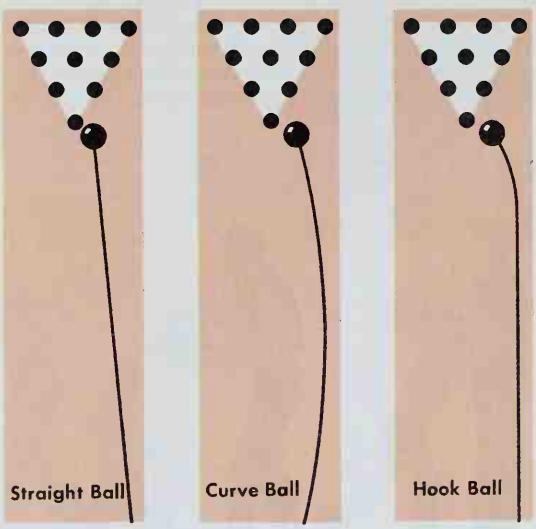
Bowling terms

Brooklyn is a strike made when a right-handed bowler's ball hits on the left side of the head pin, or when a left-handed bowler's ball hits on the right side of the head pin.
Cherry occurs when the ball knocks down only the front pin or pins in an attempt for a spare.
Frame is one tenth of a game. A player can roll twice in each frame but the tenth. In the tenth frame, a player can roll three times. The score is marked in a *frame,* or square, on the score sheet.
Loft means to throw the ball into the air so that it drops on the alley beyond the foul line.
Spare occurs when a bowler knocks down all 10 pins with two balls in the same frame.
Split, or *railroad,* occurs when a ball leaves two or more pins standing that are not close together.
Strike occurs when a bowler knocks down all 10 pins with the first ball.
Tap occurs when a pin remains standing after an apparently perfect hit.
Turkey is three strikes in a row.

How to bowl

One reason for bowling's popularity is the ease with which the game can be learned. The bowler starts the delivery about 12 feet (3.7 meters) from the foul line. This line separates the approach end of the lane from the lane itself. The bowler must release the ball without crossing the foul line.

Scoring. A bowling game consists of 10 frames. Each bowler rolls the ball twice in each frame, unless a strike is scored. A *strike* counts 10 pins, plus the total number of pins the bowler knocks down with the next two balls that are thrown. On a strike, the scorer marks an *X* in the small square in the corner of the larger square on the score sheet. A *spare* counts 10 pins, plus the number of pins the bowler knocks down with the first ball thrown



Bowlers throw three kinds of balls—a straight ball, a curve, or a hook. No matter what kind is used, a right-handed bowler aims for the *pocket* between the first and third pins. A left-handed bowler tries to hit between the first and second pins.

SCORE SHEET

NAME	1	2	3	4	5	6	7	8	9	10	TOTAL
GORDON	X 30	X 60	X 90	X 120	X 150	X 180	X 210	X 240	X 270	X X X 300	300
DICK	X 20	7 / 40	X 60	8 / 80	X 100	9 / 120	X 140	9 / 160	X 180	9 / X 200	200
JOHN	7 / 17	7 / 32	5 / 51	9 / 69	8 / 88	9 / 106	8 / 123	7 / 139	6 / 156	7 / 9 175	175
DON	7 2 9	9 - 18	X 37	7 2 46	7 / 66	X 86	7 / 105	9 / 124	9 / 144	X 9 / 164	164

Scoring a game. Each line on the score sheet has 10 large squares, called *frames.* Ten frames are a game. The two small squares in each frame are for the pins knocked down by each of the two balls a bowler may roll in a frame. In the first frame, *above,* the fourth man got 7 pins on his first ball and 2 on his second for a total of 9. An X in the first small square stands for a strike. A diagonal line in the second small square is for a spare. A short dash in this square means the bowler missed the standing pins with his second ball. For an explanation of how to add strikes and spares, see the *Scoring* section in this article.

in the next frame. The scorer marks a diagonal line (/) through the small square for a spare. When a bowler fails to make a strike or spare, only the pins knocked down count, and no scoring is carried over to the next frame. If the bowler fails to knock down all the pins with two balls in one frame, he or she scores an *error.* The scorer marks a dash (—) or the word "open" in the small square. A bowler must roll 12 consecutive strikes to score 300, a perfect game. This includes one strike for each of the 10 frames, plus one strike for each of the two extra, or bonus, chances that a bowler receives for scoring a strike in the 10th frame.

Bowling for spares. A successful bowler must be able to score spares, or knock down with a second ball all the pins left standing after his or her first ball in a frame. The bowler usually rolls from the left side of the lane if the remaining pins are on the right side of the lane. If the pins stand on the left side of the lane, the bowler generally delivers the ball from the right side.

Delivering the ball. Most bowlers use a four-step or five-step delivery. The bowler takes a relaxed stance at the starting point. He or she faces the pins and holds the ball slightly above the waist. A right-handed bowler using the four-step delivery steps forward on the right foot and pushes the ball forward and down. On the second step (left foot), the bowler swings the ball back to the rear, and the left arm moves forward for balance. In the five-step delivery, the bowler starts on the left foot and takes two steps while swinging the ball back.

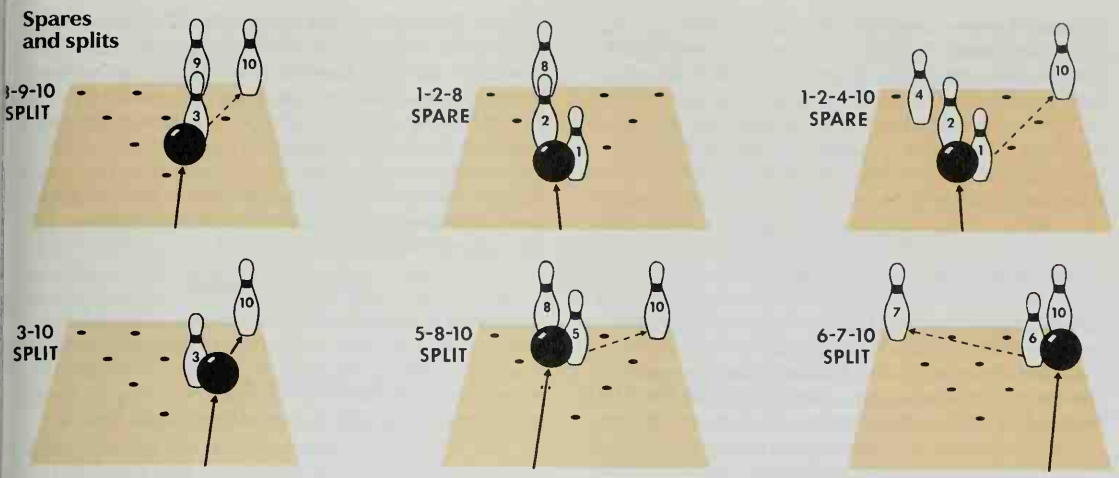
In both the four- and five-step deliveries, the ball reaches the top of its backswing when the bowler has the right foot forward. The next step (left foot) brings the bowler to the foul line in a graceful slide. The bowler rolls the ball down the lane and lets the right hand follow through smoothly. This hand should end its swing almost in front of the bowler's eyes.

Bowlers should throw either a straight ball, a hook, or a curve. The *straight ball* is best for a beginner, because it is the easiest to throw accurately. The *hook ball* rolls down the side of the lane, then turns sharply in toward the pins. The *curve ball* follows a wider arc than the hook does. For a hook or a curve, the bowler spins the ball by twisting the wrist as the ball leaves the hand.

Aiming. A right-handed bowler aims for the *pocket,* or space, between the 1 and 3 pins, while a left-handed bowler tries to hit the pocket between the 1 and 2 pins. A bowler uses either pin bowling or spot bowling to aim. In *pin bowling,* the bowler keeps his or her eyes on the pins throughout approach and delivery, and aims the ball directly at the pins. In *spot bowling,* the bowler chooses a spot marked on the lane over which the ball must pass in order to hit the pins correctly. The bowler keeps his or her eyes on this spot, and aims at the spot instead of at the pins.

The four-step delivery

Start with the feet together. (1) Step forward on the right foot, extending the ball, and start the downswing. (2) Bring the ball into the backswing as the left foot comes forward. (3) As the ball reaches the top of the backswing, move the right foot forward.



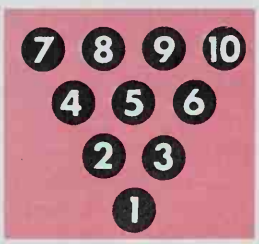
A spare is scored when a bowler needs two balls to knock over all the pins. The arrangement of pins left standing after a bowler rolls the first ball is often called a *split.* This means some of the pins have more than one pin-space between them. Pins clustered without any extra space between them are sometimes called *spares,* and are usually easier to knock over than splits.

Bowling equipment

The ball is made of a variety of materials, depending on the bowler's skill level. Beginning and average bowlers normally use balls made of plastic and regular urethane, which are easier to control. High-average and professional bowlers usually use resin balls and urethane balls containing particles of ceramic, glass, and other materials. These balls have a stickier surface that provides more hooking action and hitting power. Balls used in leagues must weigh from 6 to 16 pounds (2.7 to 7.3 kilograms). Most bowlers use a *three-finger grip* (thumb, middle finger, and ring finger). The thumb and fingers should slip into the holes only up to the second knuckle. Some bowlers use a fingertip grip, extending the fingers into the holes only up to the first knuckle.

The lane is 62 feet 10 $\frac{3}{16}$ inches (19.16 meters) long and 41 to 42 inches (1.04 to 1.07 meters) wide. The approach area, at the bowler's end of the lane, is at least 15 feet (4.6 meters) long. The foul line separates the approach area from the lane. Shallow, hollowed grooves called *gutters* run along either side of the lane. A gutter is 9 inches (23 centimeters) wide. Poorly aimed balls roll into a gutter. Most bowling lanes are made of synthetic material, generally with a polymer-base surface.

The pins are made of maple and are covered with a plastic coating. Magnesium pins are also permitted, but they are still in a developmental stage. Each pin stands 15 inches (38 centimeters) high. A pin must be at least 5 $\frac{1}{4}$ inches (13.3 centimeters) in circumference at the neck and no more than 15 inches (38 centimeters) in circumference at its widest point. Pins weigh from 3 pounds 6 ounces (1.53 kilograms) to 3 pounds 12 ounces (1.7 kilograms). The heaviest pin may not weigh more than 3



Bowling pins are set up in the form of a triangle. Each pin has its own number. Splits are named by the numbers of the pins left standing after a ball has been rolled.

American Bowling Congress

(4) Go into a slide on the left foot and start the downswing. (5) As the slide ends, release the ball, thumb first. The right hand follows through and ends its swing almost in front of the eyes. Left-handed bowlers use the opposite foot moves.

ounces (85 grams) more than the lightest pin.

The pins stand on spots in a 36-inch (91-centimeter) triangle. The center of each spot is 12 inches (30 centimeters) from the center of the neighboring spots. The pins are numbered from 1 to 10, starting with the No. 1 (head) pin and counting row by row, from left to right. The No. 1 pin stands 60 feet (18 meters) from the foul line at the far end of the lane.

Professional bowling

Some bowlers once earned a living from the sport by giving exhibitions and lessons, and sometimes by competing for prize money. Organized professional bowling began in 1959, with the founding of the men's Professional Bowlers Association (PBA) and the Professional Woman Bowlers Association (PWBA). In 1978, the PWBA became the Women Professional Bowlers Association (WPBA). The WPBA broke up in 1981. The Ladies Pro Bowlers Tour, founded in 1981, replaced the WPBA. In 1998, the Ladies Pro Bowlers Tour changed its name to the Professional Women's Bowling Association (PWBA). The PBA and the PWBA each sponsor dozens of national tournaments. Both organizations also sponsor tournaments with local organizations of bowling-establishment owners, civic and fraternal organizations, and corporations. Tournaments have been held in major cities throughout the world.

Canadian fivepins

Fivepins is a popular form of bowling in Canada. Bowlers roll a ball that is 5 inches (13 centimeters) or less in diameter and weighs 56 ounces (1.59 kilograms) or less. Five pins, 12 inches (30 centimeters) apart, stand in a triangle at the end of a regulation 10-pin lane.

Major tournament champions

PBA World Championship

Year		Year		Year		Year	
1960	Don Carter	1972	Johnny Guenther	1984	Bob Chamberlain	1996	Butch Soper
1961	Dave Soutar	1973	Earl Anthony	1985	Mike Aulby	1997	Rick Steelsmith
1962	Carmen Salvino	1974	Earl Anthony	1986	Tom Crites	1998	Pete Weber
1963	Billy Hardwick	1975	Earl Anthony	1987	Randy Pedersen	1999	Tim Criss
1964	Bob Strampe	1976	Paul Colwell	1988	Brian Voss	2000	Norm Duke
1965	Dave Davis	1977	Tommy Hudson	1989	Pete Weber	2001	Walter Ray Williams, Jr.
1966	Wayne Zahn	1978	Warren Nelson	1990	Jim Pencak		
1967	Dave Davis	1979	Mike Aulby	1991	Mike Miller	2002	Doug Kent
1968	Wayne Zahn	1980	Johnny Petraglia	1992	Eric Forkel		
1969	Mike McGrath	1981	Earl Anthony	1993	Ron Palombi, Jr.		
1970	Mike McGrath	1982	Earl Anthony	1994	David Traber		
1971	Dave Davis	1983	Earl Anthony	1995	Scott Alexander		

U.S. Open

1971	Mike Lemongello	1980	Steve Martin	1989	Mike Aulby	1998	Walter Ray Williams, Jr.
1972	Don Johnson	1981	Marshall Holman	1990	Ron Palombi, Jr.		
1973	Mike McGrath	1982	Dave Husted	1991	Pete Weber	1999	Bob Learn, Jr.
1974	Larry Laub	1983	Gary Dickinson	1992	Robert Lawrence	2000	Robert Smith
1975	Steve Neff	1984	Mark Roth	1993	Del Ballard, Jr.	2001	Mika Koivuniemi
1976	Paul Moser	1985	Marshall Holman	1994	Justin Hromek		
1977	Johnny Petraglia	1986	Steve Cook	1995	Dave Husted		
1978	Nelson Burton, Jr.	1987	Del Ballard, Jr.	1996	Dave Husted		
1979	Joe Berardi	1988	Pete Weber	1997	No tournament		

American Bowling Congress Masters Champions

1998	Mike Aulby	2000	Mika Koivuniemi	2001	Parker Bohn III	2002	Brett Wolfe
1999	Brian Boghosian						

Women's U.S. Open

1949	Marion Ladewig	1963	Marion Ladewig	1977	Betty Morris	1991	Anne Marie Duggan
1950	Marion Ladewig	1964	LaVerne Carter	1978	Donna Adamek	1992	Tish Johnson
1951	Marion Ladewig	1965	Ann Slattery	1979	Diana Silva	1993	Dede Davidson
1952	Marion Ladewig	1966	Joy Abel	1980	Pat Costello	1994	Aleta Sill
1953	Marion Ladewig	1967	Gloria Bouvia	1981	Donna Adamek	1995	Cheryl Daniels
1954	Marion Ladewig	1968	Dottie Fothergill	1982	Shinobu Saitoh	1996	Liz Johnson
1955	Sylvia Wene	1969	Dottie Fothergill	1983	Dana Miller	1997	No tournament
1956	Anita Cantaline	1970	Mary Baker	1984	Karen Ellingsworth	1998	Aleta Sill
1957	Marion Ladewig	1971	Paula Sperber	1985	Pat Mercatanti	1999	Kim Adler
1958	Merle Matthews	1972	Lorrie Koch	1986	Wendy Macpherson	2000	Tennelle Grijalva
1959	Marion Ladewig	1973	Millie Martorella	1987	Carol Norman	2001	Kim Terrell
1960	Sylvia Wene	1974	Patty Costello	1988	Lisa Wagner		
1961	Phyllis Notaro	1975	Paula Sperber	1989	Robin Romeo		
1962	Shirley Garms	1976	Patty Costello	1990	Dana Miller-Mackie		

Brunswick International Tournament of Champions

1995	Mike Aulby	1997	John Gant	1999	Jason Couch	2000	Jason Couch
1996	Dave D'Entremont	1998	Bryan Goebel				

The pins are 12 $\frac{3}{8}$ inches (31.4 centimeters) high, and have a diameter of 1 $\frac{31}{64}$ inches (3.8 centimeters) at the neck and 4 $\frac{3}{16}$ inches (10.6 centimeters) at the widest point. A 1-inch (2.5-centimeter) groove located 2 inches (5 centimeters) from the base holds a rubber band.

The No. 5 (head) pin stands at the corner of the triangle nearest the bowler. Two No. 3 pins stand behind the head pin, and two No. 2 pins form the back corners of the triangle. A game has 10 frames, and each bowler can roll three times in a frame unless a strike or a spare is scored. A strike counts 15, plus the number of pins knocked down with the next two balls. A spare counts 15 points, plus the number of pins knocked down with the first ball in the next frame.

Other kinds of bowling

Other bowling games include duckpins, candlepins, lawn bowling, boccie, and ninepins.

Duckpins and candlepins are 10-pin bowling games that use a smaller ball and different-shaped pins. Both games allow the bowler to roll a third ball in each frame. The duckpins ball can be a maximum of 5 inches (12.7 centimeters) in diameter and weigh no more than 3 pounds 12 ounces (1.7 kilograms). The stubby duckpins stand 9 $\frac{13}{32}$ inches (23.9 centimeters) high. In candlepins, the ball is 4 $\frac{1}{2}$ inches (11.5 centimeters) in diameter and can weigh a maximum of 2 pounds 7 ounces (1.1 kilograms). Candlepins are 15 $\frac{3}{4}$ inches (40 centimeters) high. They are flat at the base and the top and slightly wider in the middle. Both duckpins and candlepins are popular in the eastern United States and eastern Canada.

Lawn bowling, an outdoor game, is popular in Canada and Britain (see **Lawn bowling**).

Boccie is an Italian form of lawn bowling.

Ninepins is a game in which the bowler rolls the ball at nine pins set in a diamond formation. The game is popular in northern Europe.

History

Beginnings. People have competed in various forms of bowling for thousands of years. The earliest evidence of the sport dates back to ancient Egypt. Archaeologists discovered equipment for a game resembling bowling that had been buried with a child about 5200 B.C.

The ancient Polynesians played a game that involved rolling small balls at round, flat disks about 4 inches (10 centimeters) in diameter. They rolled the balls 60 feet (18 meters), the distance used in bowling today.

Modern forms of bowling can be traced back to the Middle Ages. In Germany, village dances and celebrations of baptisms included bowling. The Germans rolled or threw stones at nine wooden clubs called *kegles,* and bowlers today are sometimes known as *keglers.*

Bowling appeared in England as early as the 1100's. The game became so popular that English people began to consider it more important than archery. But archery had such a vital role in the defense of England that Parliament outlawed bowling for a time.

In the Netherlands, people played a game called *Dutch pins.* They arranged nine tall, slender pins in a diamond. The pins were spaced widely apart. The bowler who first knocked down 31 pins, and no more than that number, won the game. A bowler could also win by knocking over the middle pin—called the *kingpin*—without toppling any others. The Dutch brought their version of bowling with them when they immigrated to the New World during the 1600's. The Dutch residents of what is now New York City bowled in a section of Manhattan still called Bowling Green.

Bowling became increasingly popular in New England during the 1800's. But gambling on the sport became so widespread that bowling came to be considered a social evil. In 1841, the Connecticut legislature outlawed "bowling at nine pins." Bowlers evaded the ban by adding a pin—and thus started the 10-pin bowling game.

The 1900's. The American Bowling Congress (ABC) was organized in 1895. It established standard playing rules and specifications for balls, pins, and lanes. The ABC conducted its first annual tournament in 1901. Today, the ABC has a membership of about 3 million who bowl in organized competition. The Women's International Bowling Congress (WIBC), organized in 1916, directs women's competition. The WIBC ranks as the world's largest sports organization for women.

During the early 1900's, most bowling establishments were small, dimly lit, smoke-filled places. Few people considered them suitable for families. In 1932, the Bowling Proprietors' Association of America was formed to raise the standards of bowling establishments. By the mid-1900's, the sport had become an accepted form of family recreation.

Until 1951, bowling pins were set by a machine that was loaded and operated by hand. That year, the introduction of an automatic pinspotting machine sped up the game greatly. Use of the new machine quickly led to the construction of large, modern bowling centers.

Every four years, the International Bowling Federation (Fédération Internationale des Quilleurs, or FIQ) sponsors a world tournament for amateur bowlers. The tournament determines both individual and team champions. In 1971, the tournament took place in Milwaukee, the first time the event was held in the United States.

In 1973, the National Bowling Hall of Fame and Museum opened in Greendale, Wisconsin. It moved to St. Louis, Missouri, in 1984.

Nelson Burton, Jr.

Related articles in *World Book* include:

American Bowling Congress
Carter, Don
Ladewig, Marion
Lawn bowling
Roth, Mark
Women's International Bowling Congress

Additional resources

Aulby, Mike, and others. *Bowling 200+.* Contemporary Bks., 1989.

Borden, Fred, and Elias, Jay. *Bowling.* 1986. Reprint. Bowling Concepts, 1987.

Pezzano, Chuck. *Bowling Basics.* Prentice-Hall, 1984. Younger readers.

Showers, Norman E. *Bowling.* 3rd ed. Scott, Foresman, 1980.

Bowwood. See **Osage orange.**

Box, also called *boxwood,* is the name of about 30 species of slow-growing evergreen shrubs or small trees. Boxwoods are native to Asia, Europe, Central America, northern Africa, and the West Indies. People often use these shrubs for hedges. The *common boxwood* is cultivated along the Atlantic Coast. The *Japanese boxwood* is grown in warm regions of the United States, especially the South.

The box tree may grow as high as 25 feet (7.6 meters).

It has small, glossy leaves and clusters of small flowers. The wood is close-grained, hard, and heavy. Wood engravings are often cut from boxwood blocks. The wood is also used in making mathematical instruments, and, since Roman times, it has been used to make wind instruments. Fred T. Davies, Jr.

Scientific classification. Boxwoods are in the box family, Buxaceae. The common boxwood is *Buxus sempervirens.* The Japanese boxwood is *B. microphylla.*

Boxelder is a species of maple whose leaves differ from those of other maples. Boxelders have *compound leaves* with three to seven blades. Other maples have *simple leaves* that consist of only one blade. Boxelders are medium-sized trees and may grow to 70 feet (21 meters) tall. They do not make good shade trees because the wood is weak and the branches break off easily. Boxelders are found throughout North America, usually in lowland areas and along streams. See also **Boxelder bug; Maple** (Boxelder); **Tree** (Broadleaf trees [picture]).

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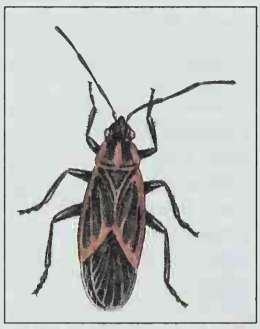
Boxelder leaves differ from those of other maples. Boxelders have *compound leaves* with several blades, *left.* Leaves of other maples, such as the sugar maple, *right,* have a single blade.

Michael J. Baranski

Scientific classification. The boxelder is in the maple family, Aceraceae. It is *Acer negundo.*

Boxelder bug is an insect that lives throughout the eastern and midwestern United States. The boxelder bug is black and measures about $\frac{1}{2}$ inch (1.3 centimeters) long. The middle section of the body and the wings are edged with bright red lines. Boxelder bugs have slender, sucking mouthparts. They feed on the leaves, flowers, and seeds of boxelder, maple, and ash trees, but they cause little damage.

In autumn, boxelder bugs search for a warm place to spend the winter. They often settle in large numbers on the sunny side of a tree, rock, or building. Homeowners may find them on steps or foundations. Boxelder bugs do not bite and will not damage a home or its furnishings. In spring, the bugs fly back to their sources of food.



WORLD BOOK illustration by John F. Eggert

Boxelder bug

Homeowners can usually control boxelder bugs by planting only male boxelder trees. These trees produce pollen, but not the seeds that attract the bugs. John R. Meyer

Scientific classification. The boxelder bug belongs to the family Rhopalidae. Its scientific name is *Leptocoris trivittatus.*

Boxer is a medium-sized dog of a breed developed in Germany. It received its name from its playful habit of striking out with its front legs. The boxer was developed from several other breeds and was crossed with the bulldog by German breeders in the 1800's. The boxer is stocky and muscular. It moves quickly and has an alert manner. Its coat is short, shiny, and fawn- or brindle-colored. Sometimes it is striped. The boxer has a deep strong chest, a wide skull, and large eyes. It is 21 to 24 inches (53 to 61 centimeters) tall at the shoulder and weighs from about 60 to 75 pounds (27 to 34 kilograms). It is often used as a war dog and as a guide for the blind. See **Dog** (picture: Working dogs); **Dog guide.**

Critically reviewed by the American Kennel Club

Boxer Rebellion was a bloody uprising in northern China in 1900 in which hundreds of Chinese and more than 200 others were killed. The Boxer Rebellion climaxed a movement in the late 1800's against the spread of Western and Japanese influence in China.

The movement was started by a secret Chinese society called *Yihequan* (Righteous and Harmonious Fists). This society was originally connected with the White Lotus sect, which opposed the Manchus, the rulers of China. Westerners nicknamed members of the group *Boxers,* because they practiced gymnastics and calisthenics. In the 1890's, the Boxers began to oppose the spread of foreign influence in China. Many other Chinese shared these anti-Western feelings, and even the Manchus secretly approved the movement.

In 1900, the Boxers set out to destroy everything they considered foreign. They slaughtered Chinese Christians, missionaries and other people from foreign countries, and anyone they found who supported Western ideas. They burned houses, schools, and churches. When foreign diplomats in Beijing sent out calls for troops, the Manchu government declared war against the foreign powers.

Boxers and government troops besieged the *legations* (official residences of foreign diplomats) in Beijing from June 21 to Aug. 14, 1900. Foreign guards, civilians, and Chinese Christians courageously resisted. Finally, a rescue force from eight nations crushed the uprising.

On Sept. 7, 1901, the Manchu government and representatives of 11 other nations signed a final settlement, called *The Boxer Protocol.* China agreed to execute several officials and punish many others, destroy many forts, and pay about $330 million in damages. In 1908, the United States returned part of the money it had received, to be used for educational purposes. The United Kingdom and Japan later did the same.

Immanuel C. Y. Hsu

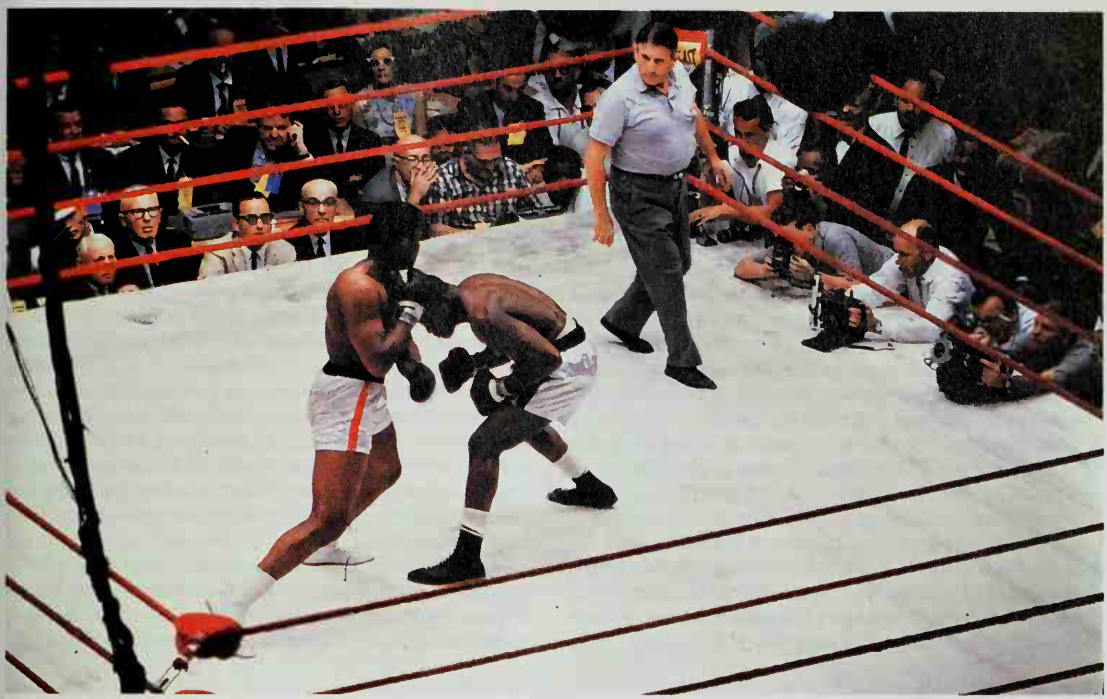
See also **China** (The fall of the Manchus); **Hay, John Milton; Open-Door Policy.**

Additional resources

Cohen, Paul A. *History in Three Keys: The Boxers as Event, Experience, and Myth.* Columbia Univ. Pr., 1997.

Esherick, Joseph. *The Origins of the Boxer Uprising.* Univ. of Calif. Pr., 1987.

Preston, Diana. *The Boxer Rebellion.* Walker, 2000.



UPI/Bettmann Archive

A boxing match is fought in a roped-off area called a *ring*. The floor has a canvas covering stretched over felt or foam rubber. A referee in the ring makes sure the two boxers obey the rules. In this photo, Muhammad Ali, *left,* defeated Sonny Liston to win the heavyweight championship in 1964.

Boxing

Boxing is a sport in which two fighters battle with their fists. The boxers wear heavily padded gloves and fight in a square, roped-off area called a *ring*. A good *bout* between two well-matched fighters is a fast, violent display of strength and skill. The boxers throw powerful punches as each tries to dominate his opponent. At the same time, each boxer must guard his head and body against the other's punches by dodging or blocking the blows. There are several ways to win a fight. See the *Scoring a fight* section in this article. The action may range all over the ring as the fighters weave about or press forward to create openings for blows. Good boxers must be strong, quick, skillful, and in excellent physical condition. They also should have the courage and determination to fight in spite of pain and exhaustion.

Boxers fight as amateurs or professionals. Most amateurs compete as members of an organization or a team, and some box in tournaments. Amateurs may not accept money for boxing. Professionals fight for money and are often called *prizefighters.*

Boxing began thousands of years ago, and for much of its history was an extremely brutal sport. Modern boxing enjoyed great popularity in the United States from the 1920's through the 1940's. However, spectator interest in the sport of boxing then began to decline. Today, only the top professional championship bouts and competition in boxing during the Olympic Games regularly draw widespread attention from the public.

Boxing has been criticized as a dangerous sport because of the possibility of injury. However, rules attempt to reduce the chances of damage to boxers. Fighters must wear protective equipment and a doctor must be present at fights. Beginning in the 1980's, most professional fights were reduced from 15 to 12 rounds to cut down on injuries due to fatigue in late rounds.

Boxing regulations

This section describes the boxing rules that are followed in the United States and in international and Olympic Games competitions. The boxing rules differ somewhat between amateur and professional boxing. The chief differences are noted in the discussion.

Weight classes. Boxers compete in classes, or divisions, based on their weight. To fight in a particular class, a boxer may not weigh more than the maximum for that class. The tables in this article give the weight range in each class for professionals and amateurs.

The ring is the area inside the ropes. At least three ropes, attached to posts near each corner, establish the dimensions of the ring. The ring may measure from 16 to 20 feet square (4.9 to 6 meters) for amateur bouts, or 16 to 24 square feet (4.9 to 7.3 meters) for professional bouts. The ring floor stands 3 to 4 feet (0.9 to 1.2 meters) higher than the arena floor, and has a canvas covering

stretched over felt or foam rubber. For professional championship fights, the boxers may select the ring size with the local boxing commission's approval.

Equipment. A boxer's hands are wrapped in soft cloth bandages. Over the bandages, he wears padded leather gloves. The gloves soften his punches and so help protect his hands as well as his opponent from injury. Some U.S. states require the use of thumbless gloves to reduce potential eye injuries. Boxing gloves weigh from 6 to 12 ounces (170 to 340 grams).

Boxers wear trunks and lightweight shoes. A *mouthpiece* of hard rubber protects the teeth, and a plastic *cup* protects the groin area. Amateurs and professionals wear a protective leather helmet when they are training. Amateurs may also wear a helmet in competition, though professionals do not. The helmet covers the back and sides of the head and the ears.

Time periods of a boxing match are called *rounds.* Each round lasts two or three minutes in amateur matches. Rounds in major professional bouts last three minutes. In all matches, there is a one-minute rest period between rounds. A professional bout may be scheduled for 4 to 15 rounds. Most professional championships are 12 rounds. Amateur fights, including championships, are scheduled for either 3 three-minute rounds or 5 two-minute rounds.

Fight officials. During a round, the *referee* is the only person in the ring besides the boxers. He sees that the fighters obey the rules. The referee warns a boxer who violates a rule. He may disqualify a fighter for committing a serious violation or for committing too many violations.

Two or three *judges* sit at ringside and score most fights. However, amateur championship fights require five judges. The *timekeeper* keeps track of the time and sounds a bell to signal the beginning and end of each round. This person also begins the knockdown count that the referee picks up and continues. An *official ring physician* is present at every bout to provide medical treatment and also to advise the referee how serious an injured fighter's condition may be.

Scoring a fight. A boxer wins a fight by (1) a knockout, (2) a technical knockout, (3) a decision, or (4) a disqualification. Sometimes, a professional bout may end in a *draw,* with neither fighter declared the winner. Amateur fights cannot end in a draw. In a close bout, the amateur who showed better style or committed fewer violations may win.

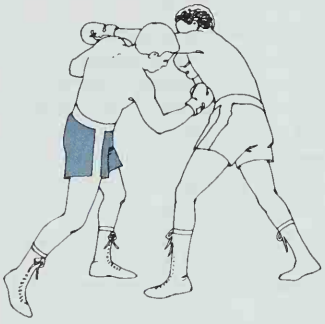
A knockout, or *KO,* occurs when a boxer is knocked down and does not get up within 10 seconds, as counted by the referee. In some U.S. states, if a round ends while a fighter is down but before 10 seconds are

Offensive boxing skills

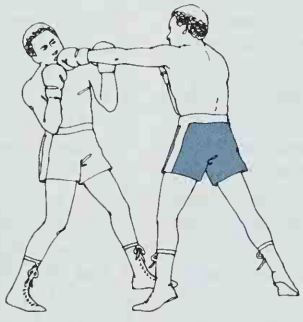
Each boxer develops an offensive style best suited to his abilities. For example, some fighters rely on speed, and others on strength. But all boxers adopt a basic *stance* (posture) and use certain key punches. The stance and four of these punches are shown at the right. The proper stance provides a boxer with the greatest possibilities for defense as well as for offense. The stance shown here is used by right-handed boxers. Many left-handers adopt the same stance, though others reverse it.

The basic stance helps a boxer move quickly and easily. He keeps his left foot in front of the right one. He holds his left fist before the left shoulder and his right fist to the right of the chin.

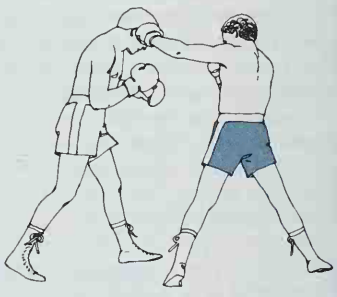
The straight right is probably the most powerful punch. A boxer's whole right side swings forward as he delivers the blow. His arm should be completely extended as the punch lands.



The uppercut is a short punch delivered with an upward motion. A boxer first lowers his fist and bends his knees. As he begins the upward swing, he pivots on his right foot and straightens his knees.



The left jab is a punch to the head. A boxer snaps his left fist out in a straight line from his shoulder. As he delivers the jab, he steps toward his opponent with his left foot.



The left hook is a blow from the side. As a boxer starts the punch, he pivots on his left foot. He then swings his left arm in an arc, moving the left side of his body forward as he lands the blow.

up, the fighter is "saved by the bell." But in most states, the count continues after the bell until the fighter either stands up or is counted out. In most states, the count stops at the bell that ends the last scheduled round.

A technical knockout, or *TKO,* occurs when a boxer is judged physically unable to continue fighting. Such a judgment may be made by the referee, the official ring physician, the fighter himself, or the fighter's assistants.

A decision results when two boxers fight the scheduled number of rounds without a knockout or a technical knockout. In most parts of the United States, three ringside judges, or the referee and two ringside judges, then decide the winner. In professional bouts, the officials may declare the fight a draw. A decision may be *unanimous,* with all three officials agreeing on the winner. Or a decision may be *split,* with the victory going to the boxer judged the winner by two of the three officials. In a *majority* decision, two of the officials judge a boxer to be the winner of the fight, with the third official scoring the bout a draw. In Olympic competition, the referee has no vote, and five judges decide the winner.

A decision is based on either the *round* or *point* system of scoring. Some states in the United States use the round system for professional bouts. In this system, the referee and the judges decide individually after every round which fighter won that round or whether it was a draw. At the end of the bout, each official votes for the fighter he has awarded the most rounds.

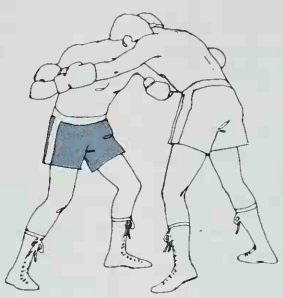
States that do not use the round system for decisions in professional fights use some form of the point system. In a point system, the referee and the judges separately award each fighter a number of points after every round based on his performance. At the end of the fight, each official adds up all the points he has given to each boxer. The boxer scored as the winner by two of the officials wins the bout. Some states use a *5-point* or *10-point must system.* In this system, each official gives the boxer he considers to be the round's winner 5 or 10 points and the loser fewer points. If an official decides the round is a draw, each boxer gets 5 or 10 points.

All decisions in U.S. and international amateur fights are based on the *20-point-must* system. Each official awards the winner of a round 20 points. The loser receives 19 points or fewer, depending on how the officials judged his performance. If the round is judged even, each fighter gets 20 points.

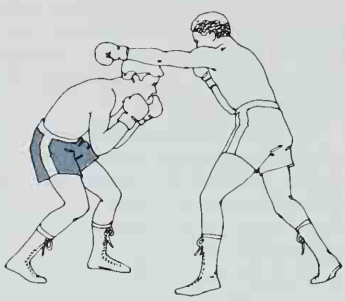
Fight rules. A boxer may not hit below the belt, in the back of the head, or strike an opponent who is down, even to one knee. Such actions are called *fouls.* Other fouls include kicking, tripping, wrestling, excessive holding, hitting an opponent's eye with the thumb of the glove, hitting with the forearm or the inside of the

Defensive boxing skills

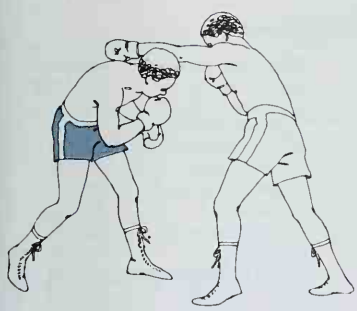
In defensive boxing, a fighter may use a number of techniques to avoid his opponent's punches or make them ineffective. A good defensive boxer can guess what offensive strategy his opponent will use. As a result, he can respond with the proper defense. Several basic defensive techniques are shown at the right.



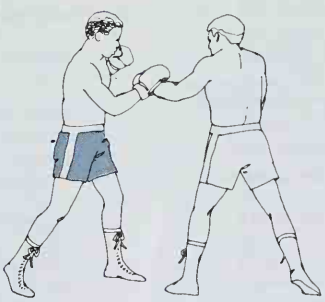
Clinching stops an opponent's attack. To clinch, a fighter grasps and holds his opponent's arms so they cannot be used. A boxer clinches when he is tired or has been stunned by his opponent's punches.



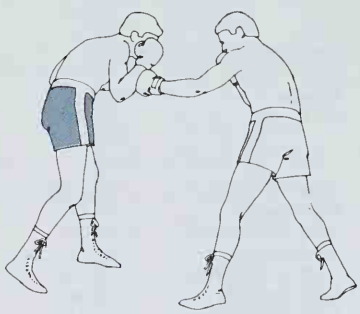
Ducking is one way to avoid blows aimed at the head. A boxer can duck a blow by stepping toward his opponent and bending at the knees and waist. The punch will then pass over his head.



Slipping is a maneuver in which a boxer moves his head to the left or right to avoid an opponent's blow. By moving only his head, a fighter stays in position to go quickly on the offensive.



Parrying is a method of turning aside a blow with the glove or forearm. A punch can be parried to either side or downward. The elbow of the parrying arm is kept close to the body to protect the ribs.



WORLD BOOK illustrations by Tak Murakami

Blocking is a technique of stopping a blow before it reaches the head or body. A boxer blocks most punches to the head with his glove. He blocks most body blows with his forearm or elbow.

glove, butting with the head, or using the elbows. A boxer who commits a foul is warned by the referee and may lose points. Too many fouls may result in disqualification.

After a fighter is knocked down, his opponent must immediately go to the farthest *neutral corner*—one of the two corners not occupied by either boxer between rounds. The referee then begins the count. If the fallen boxer rises, the count is ended. In amateur and some professional bouts, however, a fallen boxer must take a *mandatory eight-count*. Under this rule, fighting may not resume after a knockdown until the referee has counted to eight, even if the fallen boxer rises immediately. If a boxer in an amateur fight is knocked down three times in one round, his opponent wins the match on a TKO. This rule also applies to many professional bouts.

Boxing skills

In time, every boxer develops his own style. But all boxers use the same techniques of offense and defense. In the ring, a boxer adopts a basic *stance* (posture) that helps him move quickly and easily. A right-handed boxer keeps his left side toward his opponent and stands with his feet about shoulder-width apart. The boxer holds his left fist a short distance in front of the left shoulder and his right fist just to the right of the chin. He keeps his elbows close to the body to protect the ribs. Many left-handed boxers adopt this same stance, though some of them reverse it. The basic stance puts a boxer in the best position to avoid or block the punches of his opponent. This stance also allows the boxer to throw effective blows.

To create openings for his punches, a boxer uses various *feints, jabs,* and *combinations*. A feint is a faked punch. For example, a boxer may make a feint with his left hand and then deliver an actual blow with his right hand. A jab is a quick blow in which the arm is extended straight from the shoulder. The jab is effective as both an offensive and a defensive weapon. A combination consists of two or more lightning-fast punches in a row. A typical combination is a left, a right, and another left punch.

Good boxers keep in top physical condition and spend many hours practicing boxing skills. They do much *roadwork*—that is, running and jogging—to develop their endurance. They skip rope to improve their footwork, and they practice their punching ability on punching bags. When boxers are training for a bout, they practice under fight conditions by boxing with *sparring partners*.

Amateur boxing

In the United States, many schools, boys' clubs and camps, and various branches of the armed services offer boxing as part of their sports programs. The majority of this amateur competition is conducted under the regulations set by the U.S.A. Amateur Boxing Federation (USA/ABF).

The USA/ABF conducts amateur boxing championships every year. It also supervises the selection of United States boxers for the Olympic Games and various other international events. In addition, the USA/ABF is a member of the Association Internationale de Boxe Amateur (AIBA).

The annual Golden Gloves tournament is probably the most famous U.S. amateur boxing event. The nationwide tournament is approved by the USA/ABF and operates under USA/ABF rules. Local and regional elimination bouts lead to the final championship matches.

Professional boxing

Financing. Professional boxers fight for money in bouts that are arranged by *promoters*. A promoter may be an individual or a corporation. The promoter rents an arena or stadium, settles the amount to be paid each boxer, sells tickets, and takes care of all other necessary arrangements. In addition, the promoter may be able to sell television (network, cable, or closed-circuit), motion-picture, and radio rights for an important bout.

The promoter schedules several matches for the same evening. The *main event* features two top boxers. Several *preliminary* bouts between less important boxers come before the main event. Most preliminary bouts are scheduled for four or six rounds.

Most professional boxers have a *manager* to handle their business affairs. The manager makes agreements with promoters for bouts, hires the fighter's employees, and sets up a training camp. The manager may get up to a third of the prize money. A boxer's employees include a *trainer* and one to three *seconds*. The trainer drills the fighter in boxing techniques and directs strategy during

Amateur weight classes

Weight class	U.S. amateur In pounds	International and Olympic In kilograms
Super heavyweight	Over 201	Over 91
Heavyweight	179-201	81-91
Light heavyweight	166-178	76-81
Middleweight	157-165	72-75
Light middleweight	148-156	68-71
Welterweight	140-147	64-67
Light welterweight	133-139	61-63.5
Lightweight	126-132	58-60
Featherweight	120-125	55-57
Bantamweight	113-119	52-54
Flyweight	107-112	49-51
Light flyweight	Under 107	Under 49

Professional weight classes

WBA weight class	WBC weight class	In pounds
Heavyweight	Heavyweight	Over 190
Cruiserweight	Cruiserweight	176-190
Light heavyweight	Light heavyweight	169-175
Super middleweight	Super middleweight	161-168
Middleweight	Middleweight	155-160
Junior middleweight	Super welterweight	148-154
Welterweight	Welterweight	141-147
Junior welterweight	Super lightweight	136-140
Lightweight	Lightweight	131-135
Junior lightweight	Super featherweight	127-130
Featherweight	Featherweight	123-126
Junior featherweight	Super bantamweight	119-122
Bantamweight	Bantamweight	116-118
Junior bantamweight	Super flyweight	113-115
Flyweight	Flyweight	109-112
Junior flyweight	Light flyweight	106-108
Minimumweight	Strawweight	Under 106

(Text continued on page 532)

Boxing champions*

Heavyweights (WBA)

Years	Boxer
1882-92	John L. Sullivan
1892-97	James J. Corbett
1897-99	Bob Fitzsimmons
1899-1905	James J. Jeffries
1905-06	Marvin Hart
1906-08	Tommy Burns
1908-15	Jack Johnson
1915-19	Jess Willard
1919-26	Jack Dempsey
1926-28	Gene Tunney
1930-32	Max Schmeling
1932-33	Jack Sharkey
1933-34	Primo Carnera
1934-35	Max Baer
1935-37	James J. Braddock
1937-49	Joe Louis
1949-51	Ezzard Charles
1951-52	Joe Walcott
1952-56	Rocky Marciano
1956-59	Floyd Patterson
1959-60	Ingemar Johansson
1960-62	Floyd Patterson
1962-64	Sonny Liston
1964	Muhammad Ali
1965-67	Ernie Terrell
1967	Muhammad Ali
1968-70	Jimmy Ellis
1970-73	Joe Frazier
1973-74	George Foreman
1974-78	Muhammad Ali
1978	Leon Spinks
1978-79	Muhammad Ali
1979-80	John Tate
1980-82	Mike Weaver
1982-83	Michael Dokes
1983-84	Gerrie Coetzee
1984-85	Greg Page
1985-86	Tony Tubbs
1986	Tim Witherspoon
1986-87	James Smith
1987-90	Mike Tyson
1990	Buster Douglas
1990-92	Evander Holyfield
1992-93	Riddick Bowe
1993-94	Evander Holyfield
1994	Michael Moorer
1994-95	George Foreman
1995-96	Bruce Seldon
1996	Mike Tyson
1996-99	Evander Holyfield
1999-2000	Lennox Lewis
2000-01	Evander Holyfield
2001-	John Ruiz

Heavyweights (WBC)

Years	Boxer
1962-64	Sonny Liston
1964-71	Muhammad Ali
1971-73	Joe Frazier
1973-74	George Foreman
1974-78	Muhammad Ali
1978	Leon Spinks
1978	Ken Norton
1978-83	Larry Holmes
1984	Tim Witherspoon
1984-86	Pinklon Thomas
1986	Trevor Berbick
1986-90	Mike Tyson
1990	Buster Douglas
1990-92	Evander Holyfield
1992	Riddick Bowe
1992-94	Lennox Lewis
1994-95	Oliver McCall
1995-96	Frank Bruno
1996	Mike Tyson
1997-2001	Lennox Lewis
2001	Hasim Rahman
2001-	Lennox Lewis

Light heavyweights (WBA)

Years	Boxer
1903	Jack Root
1903	George Gardner
1903-05	Bob Fitzsimmons
1905-12	Jack O'Brien
1912-16	Jack Dillon
1916-20	Battling Levinsky
1920-22	Georges Carpentier
1922	Gene Tunney
1922-23	Harry Greb
1923	Gene Tunney
1923-25	Mike McTigue
1925-26	Paul Berlenbach
1926-27	Jack Delaney
1927-29	Tommy Loughran
1930-32	Max Rosenbloom
1932-34	George Nichols
1934-35	Bob Olin
1935-39	John Henry Lewis
1939	Melio Bettina
1939-41	Billy Conn
1941	Anton Christoforidis
1941-48	Gus Lesnevich
1948-50	Freddie Mills
1950-52	Joey Maxim
1952-61	Archie Moore
1961-63	Harold Johnson
1963-65	Willie Pastrano
1965-66	José Torres
1966-68	Dick Tiger
1968-70	Bob Foster
1971-72	Vincente Rondon
1972-74	Bob Foster
1974-78	Victor Galindez
1978-79	Mike Rossman
1979	Victor Galindez
1979-80	Marvin Johnson
1980-81	Eddie Mustafa Muhammad
1981-85	Michael Spinks
1986-87	Marvin Johnson
1987	Leslie Stewart
1987-91	Virgil Hill
1991-92	Thomas Hearns
1992	Iran Barkley
1992-97	Virgil Hill
1997	Darius Michalczewski
1997-98	Lou Del Valle
1998-2001	Roy Jones, Jr.
2001-	Bruno Girard

Light heavyweights (WBC)

Years	Boxer
1963-65	Willie Pastrano
1965-66	José Torres
1966-68	Dick Tiger
1968-74	Bob Foster
1974-77	John Conteh
1977-78	Miguel Cuello
1978	Mate Parlov
1978-79	Marvin Johnson
1979-81	Matthew Saad Muhammad
1981-83	Dwight Muhammad Qawi
1983-85	Michael Spinks
1985-86	J. B. Williamson
1986-87	Dennis Andries
1987	Thomas Hearns
1987-88	Donny Lalonde
1988	Sugar Ray Leonard
1989	Dennis Andries
1989-90	Jeff Harding
1990-91	Dennis Andries
1991-94	Jeff Harding
1994-95	Mike McCallum
1995-96	Fabrice Tiozzo
1996-97	Roy Jones, Jr.
1997	Montell Griffin
1997-	Roy Jones, Jr.

Middleweights (WBA)

Years	Boxer
1884-91	Jack "The Nonpareil" Dempsey
1891-97	Bob Fitzsimmons
1897-1907	Tommy Ryan
1908	Stanley Ketchel
1908	Billy Papke
1908-10	Stanley Ketchel
1910-13	Disputed
1913	Frank Klaus
1913-14	George Chip
1914-17	Al McCoy
1917-20	Mike O'Dowd
1920-23	Johnny Wilson
1923-26	Harry Greb
1926	Tiger Flowers
1926-31	Mickey Walker
1931-32	Gorilla Jones
1932-36	Marcel Thil
1936-38	Freddie Steele
1938	Al Hostak
1938-39	Solly Krieger
1939-40	Al Hostak
1940-47	Tony Zale
1947-48	Rocky Graziano
1948	Tony Zale
1948-49	Marcel Cerdan
1949-51	Jake LaMotta
1951	Sugar Ray Robinson
1951	Randy Turpin
1951-52	Sugar Ray Robinson
1953-55	Bobo Olson
1955-57	Sugar Ray Robinson
1957	Gene Fullmer
1957	Sugar Ray Robinson
1957-58	Carmen Basilio
1958-59	Sugar Ray Robinson
1959-62	Gene Fullmer
1962-63	Dick Tiger
1963-65	Joey Giardello
1965-66	Dick Tiger
1966-67	Emile Griffith
1967	Nino Benvenuti
1967-68	Emile Griffith
1968-70	Nino Benvenuti
1970-77	Carlos Monzón
1977-78	Rodrigo Valdes
1978-79	Hugo Corro
1979-80	Vito Antuofermo
1980	Alan Minter
1980-87	Marvin Hagler
1987-89	Sumbu Kalambay
1989-91	Mike McCallum
1992-93	Reggie Johnson
1993-94	John David Jackson
1994-95	Jorge Castro
1995-96	Shinji Takahara
1996-97	William Joppy
1997-98	Julio Cesar Green
1998-2001	William Joppy
2001	Felix Trinidad
2001	Bernard Hopkins
2001-	William Joppy

Middleweights (WBC)

Years	Boxer
1962-63	Dick Tiger
1963-65	Joey Giardello
1965-66	Dick Tiger
1966-67	Emile Griffith
1967	Nino Benvenuti
1967-68	Emile Griffith
1968-70	Nino Benvenuti
1970-74	Carlos Monzón
1974-76	Rodrigo Valdes
1976-77	Carlos Monzón
1977-78	Rodrigo Valdes
1978-79	Hugo Corro
1979-80	Vito Antuofermo
1980	Alan Minter
1980-87	Marvin Hagler
1987	Sugar Ray Leonard
1987-88	Thomas Hearns
1988-89	Iran Barkley
1989-90	Roberto Duran
1990-93	Julian Jackson
1993-95	Gerald McClellan
1995-96	Julian Jackson
1996	Quincy Taylor
1996-98	Keith Holmes
1998-99	Hassine Cherifi
1999-2001	Keith Holmes
2001-	Bernard Hopkins

Welterweights (WBA)

Years	Boxer
1892-94	Billy Smith
1894-96	Tommy Ryan
1896	Kid McCoy
1896-1900	Billy Smith
1900	Rube Ferns
1900-01	Matty Matthews
1901	Rube Ferns
1901-04	Joe Walcott
1904	Dixie Kid
1904-06	Joe Walcott
1906-07	Honey Mellody
1907-10	Mike Sullivan
1910-15	Disputed
1915-19	Ted Lewis
1919-22	Jack Britton
1922-26	Mickey Walker
1926-27	Pete Latzo
1927-29	Joe Dundee
1929-30	Jackie Fields
1930	Jack Thompson
1930-31	Tommy Freeman
1931	Jack Thompson
1931-32	Lou Brouillard
1932-33	Jackie Fields
1933	Young Corbett
1933-34	Jimmy McLarnin
1934	Barney Ross
1934-35	Jimmy McLarnin
1935-38	Barney Ross
1938-40	Henry Armstrong
1940-41	Fritzie Zivic
1941-46	Freddie Cochrane
1946	Marty Servo
1946-51	Sugar Ray Robinson
1951	Johnny Bratton
1951-54	Kid Gavilan
1954-55	Johnny Saxton
1955	Tony DeMarco
1955-56	Carmen Basilio
1956	Johnny Saxton
1956-57	Carmen Basilio
1958	Virgil Akins
1958-60	Don Jordan
1960-61	Benny Paret
1961	Emile Griffith
1961-62	Benny Paret
1962-63	Emile Griffith
1963	Luis Rodriguez
1963-66	Emile Griffith
1966-69	Curtis Cokes
1969-70	José Nápoles
1970-71	Billy Backus
1971-75	José Nápoles
1975-76	Angel Espada
1976-80	José Cuevas
1980-81	Thomas Hearns
1981-82	Sugar Ray Leonard
1983-86	Donald Curry
1986	Lloyd Honeyghan
1987	Mark Breland
1987-88	Marlon Starling
1988-89	Tomas Molinares
1989-90	Mark Breland
1990-91	Aaron Davis
1991-92	Meldrick Taylor
1992-94	Crisanto España
1994-98	Ike Quartey
1998-2001	James Page
2001	Andrew Lewis
2001-	Ricardo Mayorga

Welterweights (WBC)

Years	Boxer
1962-63	Emile Griffith
1963	Luis Rodriguez
1963-66	Emile Griffith
1966-69	Curtis Cokes
1969-70	José Nápoles
1970-71	Billy Backus
1971-75	José Nápoles
1975-76	John Stracey
1976-79	Carlos Palomino
1979	Wilfred Benitez
1979-80	Sugar Ray Leonard
1980	Roberto Duran
1980-82	Sugar Ray Leonard
1983-85	Milton McCrory
1985-86	Donald Curry
1986-87	Lloyd Honeyghan
1987-88	Jorge Vaca
1988-89	Lloyd Honeyghan
1989-90	Marlon Starling
1990-91	Maurice Blocker
1991	Simon Brown
1991-93	Buddy McGirt
1993-97	Pernell Whitaker
1997-99	Oscar De La Hoya
1999-2000	Felix Trinidad
2000	Oscar De La Hoya
2000-02	Shane Mosley
2002-	Vernon Forrest

Lightweights (WBA)

Years	Boxer
1886-96	Jack McAuliffe

*These tables list the WBA- and WBC-recognized champions for seven of the oldest weight classes.

(Continued on next page)

Years	Boxer
1896-99	Kid Lavigne
1899-1902	Frank Erne
1902-08	Joe Gans
1908-10	Battling Nelson
1910-12	Ad Wolgast
1912-14	Willie Ritchie
1914-17	Freddy Welsh
1917-25	Benny Leonard
1925	Jimmy Goodrich
1925-26	Rocky Kansas
1926-30	Sammy Mandell
1930	Al Singer
1930-33	Tony Canzoneri
1933-35	Barney Ross
1935-36	Tony Canzoneri
1936-38	Lou Ambers
1938-39	Henry Armstrong
1939-40	Lou Ambers
1940-41	Lew Jenkins
1941-44	Sammy Angott
1944-45	Juan Zurita
1945-51	Ike Williams
1951-52	Jimmy Carter
1952	Lauro Salas
1952-54	Jimmy Carter
1954	Paddy DeMarco
1954-55	Jimmy Carter
1955-56	Bud Smith
1956-62	Joe Brown
1962-65	Carlos Ortiz
1965	Ismael Laguna
1965-68	Carlos Ortiz
1968-69	Carlos Cruz
1969-70	Armando Ramos
1970	Ismael Laguna
1970-72	Ken Buchanan
1972-79	Roberto Duran
1979-80	Ernesto España
1980-81	Hilmer Kenty
1981	Sean O'Grady
1981	Claude Noel
1981-82	Arturo Frias
1982-84	Ray Mancini
1984-86	Livingstone Bramble
1986-87	Edwin Rosario
1987-89	Julio Cesar Chavez
1989-90	Edwin Rosario
1990	Juan Nazario
1990-92	Pernell Whitaker
1992	Joey Gamache
1992-93	Tony Lopez
1993	Dingaan Thobela
1993-98	Orzubek Nazarov
1998-99	Jean-Baptiste Mendy
1999	Julien Lorcy
1999	Stefano Zoff
1999-2000	Gilberto Serrano
2000-01	Takanori Hatakeyama
2001	Julien Lorcy
2001-02	Raul Balbi
2002-	Leonard Dorin

Lightweights (WBC)

1962-65	Carlos Ortiz
1965	Ismael Laguna
1965-68	Carlos Ortiz
1968-69	Carlos Cruz
1969-70	Armando Ramos
1970	Ismael Laguna
1970-71	Ken Buchanan
1971-72	Pedro Carrasco
1972	Armando Ramos
1972	Erubey Carmona
1972-74	Rodolfo González
1974-76	Gattu Ishimatsu
1976-78	Esteban De Jesús
1978-79	Roberto Duran
1979-81	Jim Watt
1981-83	Alexis Arguello
1983-84	Edwin Rosario
1984-85	Jose Luis Ramirez
1985-87	Hector Camacho
1987-88	Jose Luis Ramirez
1988-89	Julio Cesar Chavez
1989-92	Pernell Whitaker
1992-96	Miguel Angel Gonzalez
1996-97	Jean-Baptiste Mendy
1997-98	Steve Johnston
1998-99	Cesar Bazan
1999-2000	Steve Johnston
2000-02	Jose Luis Castillo
2002-	Floyd Mayweather, Jr.

Featherweights (WBA)

1891-97	George Dixon
1897-98	Solly Smith
1898-1900	George Dixon
1900-01	Terry McGovern
1901-02	Young Corbett
1903-04	None
1905-12	Abe Attell
1912-23	Johnny Kilbane
1923	Eugene Criqui
1923-25	Johnny Dundee
1925-27	Kid Kaplan
1927-28	Benny Bass
1928	Tony Canzoneri
1928-29	André Routis
1929-32	Battling Battalino
1932-33	Tommy Paul
1933-36	Freddie Miller
1936-37	Petey Sarron
1937-38	Henry Armstrong
1938-41	Petey Scalzo
1941	Richard Lemos
1941-43	Jackie Wilson
1943	Jackie Callura
1943-44	Phil Terranova
1944-46	Sal Bartolo
1946-48	Willie Pep
1948-49	Sandy Saddler
1949-50	Willie Pep
1950-57	Sandy Saddler
1957-59	Hogan Bassey
1959-63	Davey Moore
1963-64	Sugar Ramos
1964-67	Vicente Saldivar
1968	Raul Rojas
1968-71	Shozo Saijyo
1971-72	Antonio Gómez
1972-74	Ernesto Marcel
1974	Ruben Olivares
1974-76	Alexis Arguello
1977	Rafael Ortega
1977-78	Cecilio Lastra
1978-85	Eusebio Pedroza
1985-86	Barry McGuigan
1986-87	Stevie Cruz
1987-91	Antonio Esparragoza
1991-93	Park Young-kyun
1993-96	Eloy Rojas
1996-98	Wilfredo Vasquez
1998	Freddie Norwood
1998-99	Antonio Cermeno
1999-2000	Freddie Norwood
2000-	Derrick Gainer

Featherweights (WBC)

1963-64	Sugar Ramos
1964-67	Vicente Saldivar
1967-68	Howard Winstone
1968-69	José Legrá
1969-70	Johnny Famechon
1970	Vicente Saldivar
1970-72	Kuniaki Shibata
1972	Clemente Sánchez
1972-73	José Legrá
1973-74	Eder Jofre
1974-75	Bobby Chacón
1975	Ruben Olivares
1975-76	David Kotey
1976-80	Danny Lopez
1980-82	Salvador Sánchez
1982-84	Juan LaPorte
1984	Wilfredo Gómez
1984-88	Azumah Nelson
1988-89	Jeff Fenech
1990-91	Marcos Villasana
1991-93	Paul Hodkinson
1993	Gregorio Vargas
1993-95	Kevin Kelley
1995	Alejandro Gonzalez
1995	Manuel Medina
1995-99	Luisito Espinosa
1999	Cesar Soto
1999-2000	Prince Naseem Hamed
2000-01	Guty Espades
2001-	Erik Morales

Bantamweights (WBA)

1890-92	George Dixon
1893	None
1894-99	Jimmy Barry
1899-1900	Terry McGovern
1901-02	Harry Harris
1902-03	Harry Forbes
1903-04	Frankie Neil
1904	Joe Bowker
1905-07	Jimmy Walsh
1908-09	None
1910-14	Johnny Coulon
1914-17	Kid Williams
1917-20	Pete Herman
1920-21	Joe Lynch
1921	Pete Herman
1921-22	Johnny Buff
1922-24	Joe Lynch
1924	Abe Goldstein
1924-25	Eddie Martin
1925-27	Charley Rosenberg
1927-28	Bud Taylor
1929-35	Al Brown
1935-36	Baltazar Sangchili
1936	Tony Marino
1936-37	Sixto Escobar
1937-38	Harry Jeffra
1938-40	Sixto Escobar
1940	Georgie Pace
1940-42	Lou Salica
1942-47	Manuel Ortiz
1947	Harold Dade
1947-50	Manuel Ortiz
1950-52	Vic Toweel
1952-54	Jimmy Carruthers
1954-55	Robert Cohen
1955-57	Raul Macias
1957-59	Alphonse Halimi
1959-60	Joe Becerra
1961-65	Eder Jofre
1965-68	Masahiko Harada
1968-69	Lionel Rose
1969-70	Ruben Olivares
1970-71	Jesús Castillo
1971-72	Ruben Olivares
1972	Rafael Herrera
1972-73	Enrique Pinder
1973	Romeo Anaya
1973-74	Arnold Taylor
1974-75	Soon Hwan Hong
1975-77	Alfonso Zamora
1977-80	Jorge Lujan
1980	Julian Solis
1980-84	Jeff Chandler
1984-86	Richie Sandoval
1986	Gaby Canizales
1986-87	Bernardo Pinango
1987	Takuya Muguruma
1987	Park Chang-Young
1987-88	Wilfredo Vasquez
1988	Khaokor Galaxy
1988-89	Sung-Kil Moon
1989	Khaokor Galaxy
1989-91	Luisito Espinosa
1991-92	Israel Contreras
1992	Eddie Cook
1992-93	Eliecer Julio
1993-94	Junior Jones
1994	John Michael Johnson
1994-95	Daorung MP Petroleum
1995-96	Veerapol Sahaprom
1996	Nana Konadu
1996-97	Daorung Chuwatana
1997-98	Nana Konadu
1998-99	Johnny Tapia
1999-2001	Paul Ayala
2001-02	Eidy Moya
2002-	Johnny Bredahl

Bantamweights (WBC)

1963-65	Eder Jofre
1965-68	Masahiko Harada
1968-69	Lionel Rose
1969-70	Ruben Olivares
1970-71	Jesús Castillo
1971-72	Ruben Olivares
1972	Rafael Herrera
1972-73	Enrique Pinder
1973-74	Rafael Herrera
1974-76	Rodolfo Martínez
1976-79	Carlos Zárate
1979-83	Lupe Pintor
1983-85	Alberto Davila
1985	Daniel Zaragoza
1985-88	Miguel Lora
1988-91	Raul Perez
1991	Greg Richardson
1991-92	Joichiro Tatsuyoshi
1992-93	Victor Rabanales
1993	Jung Il Byun
1993-95	Yasuei Yakushiji
1995-96	Wayne McCullough
1996-97	S. Singmanassuk
1997-98	Joichiro Tatsuyoshi
1998-	Veerapol Sahaprom

bouts. The seconds assist the trainer.

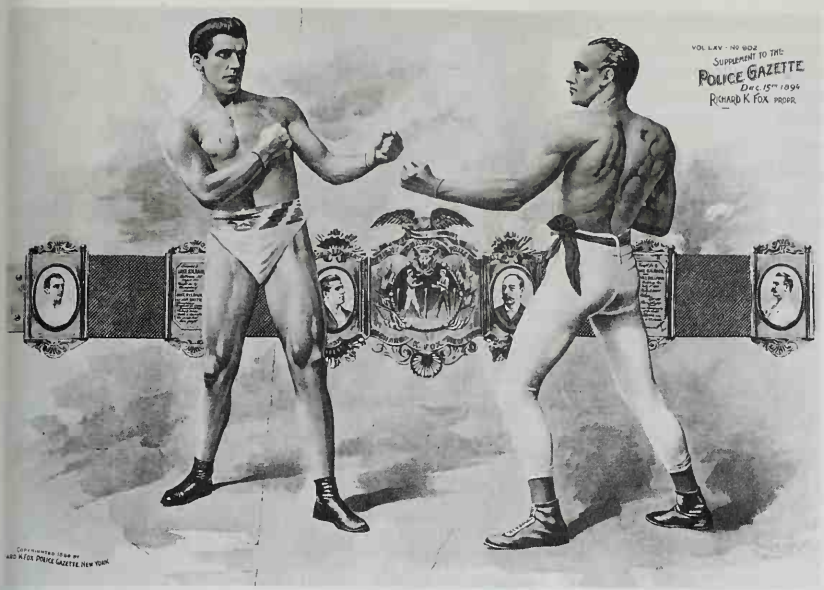
Promoters often pay less-experienced boxers a flat fee. Well-known fighters usually get a percentage of the *gate* (ticket receipts) and other revenue. They may also share in profits from the sale of entertainment rights.

Regulation. In the United States, state and local boxing commissions regulate professional boxing. Most of these commissions belong to the World Boxing Association (WBA), some to the World Boxing Council (WBC), and others to the International Boxing Federation (IBF), or to all three. The WBA, WBC, and IBF are international organizations that recommend rules to their members. Each group names its own list of world boxing champions. The three lists often differ. The Canadian Boxing Federation supervises professional boxing in Canada.

History

Ancient times. Boxing is one of the oldest known sports. Stone carvings indicate that the Sumerians, who lived in what is now Iraq, boxed at least 5,000 years ago. The sport probably spread from the Sumerians to peoples throughout the ancient world.

Boxing was a brutal spectacle in ancient Greece. Two young men would sit on flat stones, face to face, with their fists wrapped in *thongs* (strips of leather). At a signal, they began to hit each other until one of them fell to



Early boxing champions included James J. Corbett, *left,* and Bob Fitzsimmons, *right.* Corbett defeated John L. Sullivan to win the heavyweight title in 1892. Fitzsimmons defeated Corbett for the championship in 1897. Fitzsimmons also held the middleweight and light heavyweight titles during his career.

Bettmann Archive

the ground unconscious. The other man then continued to beat his opponent until he died. According to legend,the thongs were later fitted with metal spikes so that the fights ended more quickly.

The Romans also staged brutal boxing matches. On their hands and forearms, the fighters wore *cestuses,* which consisted of leather straps plated with metal. In time, the sport became so savage that the Romans forbade the use of cestuses. In the last hundred years before the birth of Christ, the Romans prohibited boxing.

The beginning of modern boxing. Boxing almost disappeared as a sport until the late 1600's, when it reappeared in England. However, it remained a cruel sport, and many fighters were crippled, blinded, or even killed while fighting.

In the early 1700's, James Figg, one of England's most famous athletes, introduced modern boxing. In Figg's day, boxing involved much wrestling. Figg became successful by punching instead of wrestling. In 1719, he opened a boxing school in London and began to teach his style of *bare-knuckle* (gloveless) fighting.

Figg's boxing rules were still brutal, however. For example, one rule required that boxers continue to fight without rest periods until one man could not go on. In 1743, Jack Broughton, a well-known British boxer, introduced new rules. Under his rules, a fight ended when one man was knocked down and could not get up within 30 seconds. However, bouts were still continuous. Broughton's rules, with some additions, became standard for all bouts. They were known as the London Prize Ring Rules, and they helped make boxing less savage.

From bare knuckles to gloves. In the mid-1860's, the Marquess of Queensberry, a British sportsman, sponsored a new boxing code of 12 rules. In 1872, the Queensberry Rules were first used in a professional tournament in London. They have been used throughout the world ever since with only slight changes. The rules require boxers to wear gloves. They also call for three-minute rounds with a one-minute rest period between rounds. The rules further state that a man down on one knee may not be struck and that a fallen man must be given 10 seconds to get back on his feet.

In the 1850's and 1860's, British boxers visited the United States, where they tried to create greater interest in boxing. But many Americans opposed the sport. It was also illegal in many areas. The matches themselves drew only small crowds that watched boxers battle with bare knuckles. In 1882, John L. Sullivan, an American, claimed the world bare-knuckle championship. But he realized that there was no future in bare-knuckle fighting and that the police allowed matches held under the Queensberry Rules. Sullivan therefore joined a traveling theatrical group and staged gloved boxing matches throughout the country. These matches attracted huge crowds.

During the 1880's, Sullivan occasionally took time off from theatrical appearances to defend his bare-knuckle championship. He defended the title the last time in 1889, when he defeated Jake Kilrain in the 75th round. The fight was the last world heavyweight bare-knuckle championship ever fought. In 1892, Sullivan fought James J. Corbett to decide the heavyweight championship under the Queensberry Rules. Corbett knocked out Sullivan in the 21st round.

The golden age of U.S. boxing. During the early 1900's, boxing remained illegal in many parts of the United States. Then in 1920, New York passed the Walker Law, which permitted public prizefighting. Soon other states legalized boxing. Boxing then grew quickly as a spectator sport and entered its golden age.

George L. (Tex) Rickard was the leading fight promoter of the 1920's. In 1921, he promoted the first match to draw a "million-dollar gate." The bout was between the U.S. heavyweight champion Jack Dempsey and the French challenger Georges Carpentier, the light heavyweight champion. Dempsey reigned as heavyweight champion from 1919 until 1926, when Gene Tunney defeated him for the title.

When Dempsey and Tunney fought again in 1927,

more than 100,000 persons paid $2,658,660, a record at that time, to watch the bout, which Tunney won.

Joe Louis became one of the most famous boxers of the golden age. He held the heavyweight title longer than any other fighter—from 1937 until he retired in 1949. Louis came out of retirement in 1950, but lost to the heavyweight champion, Ezzard Charles. He then won several comeback bouts. In 1951, in his last fight, Louis was knocked out by Rocky Marciano.

Several outstanding boxers of the golden age held the championship title in more than one weight class. Harry Greb held the light heavyweight crown from 1922 to 1923 and the middleweight crown from 1923 to 1926. Mickey Walker was the welterweight champion from 1922 to 1926 and the middleweight champion from 1926 to 1931. In the late 1930's, Henry Armstrong held the welterweight, lightweight, and featherweight titles all at the same time.

The rivalry between middleweights Tony Zale and Rocky Graziano was a boxing highlight of the 1940's. The two men fought for the championship three times. Zale knocked out Graziano in the first and third fights, and Graziano won the other.

The mid-1900's. Archie Moore, Sugar Ray Robinson, and Rocky Marciano were three of the greatest fighters of the 1950's. Moore held the light heavyweight title from 1952 to 1961. Robinson was the welterweight champion from 1946 to 1951 and then went on to win the middleweight crown five times. Marciano was the heavyweight champion from 1952 to 1956 and won all his 49 professional fights.

However, attendance at boxing matches declined during the 1950's with the rise of television. Many fans preferred to watch major fights on television at home rather than attend other fights in person. As a result, small boxing clubs, where fighters got their start in the sport, were forced out of business. In time, the general public's interest in boxing decreased to the point where

Ring Book Shop

Jack Johnson

The Ring magazine

Benny Leonard

United Press Int.

Jack Dempsey

The Ring magazine

Sugar Ray Robinson

UPI Bettmann Newsphotos

Joe Louis, *right,* was a great heavyweight champion. Louis knocked out Max Schmeling, *left,* in a famous fight in 1938.

Muhammad Speaks Newspaper

Muhammad Ali

The Ring magazine

Evander Holyfield

Great boxing champions include those shown here. Jack Johnson, Jack Dempsey, Muhammad Ali, and Evander Holyfield were heavyweight champions. Benny Leonard was a lightweight champion. Sugar Ray Robinson held the welterweight title for five years and then won the middleweight title five times.

Focus on Sports

Sugar Ray Leonard, *left,* won titles in five weight classes between 1979 and 1988. He defeated Roberto Duran, *right,* in 1980 to regain the WBC welterweight title lost to Duran.

© Al Bello, Allsport

Roy Jones, Jr., *right,* ranks among the greatest light heavyweights in boxing history. Jones became one of the few fighters to hold the WBA and WBC versions of the title at the same time.

only some championship bouts were televised.

Recent developments. Muhammad Ali became one of the most colorful fighters in boxing history and helped stimulate renewed interest in the sport in the 1960's and 1970's. Ali won the heavyweight title in 1964 with an upset victory over Sonny Liston.

A new generation of fighters sparked even greater interest in boxing during the 1980's. One of the most popular was Sugar Ray Leonard. He won a gold medal in boxing at the 1976 Olympic Games. After winning the WBC welterweight title in 1979, he fought Roberto Duran twice in 1980, first losing his title and then regaining it from Duran. In 1981, Leonard defeated previously unbeaten Thomas Hearns for the world welterweight title. In 1987, Leonard defeated Marvin Hagler for the WBC middleweight championship.

Larry Holmes was generally considered the top heavyweight of the late 1970's and early 1980's. In 1986, Mike Tyson became the youngest heavyweight ever to win a portion of the world championship when he won the WBC title at the age of 20. In 1990, Buster Douglas knocked out the previously undefeated Tyson in one of the greatest upsets in boxing history. Late in 1990, Evander Holyfield defeated Douglas to win the title. Holyfield and Lennox Lewis dominated the heavyweight division in the late 1990's and early 2000's. Holyfield defeated John Ruiz in 2001 for the WBA version of the title, becoming the first fighter to win a heavyweight title four times. Lewis has been the WBC champion almost continuously since 1997. Bert Randolph Sugar

Related articles in *World Book* include:

Ali, Muhammad
Braddock, James J.
Corbett, James J.
Dempsey, Jack
Fitzsimmons, Bob
Foreman, George
Jeffries, James J.
Johnson, Jack
Kickboxing
Leonard, Sugar Ray
Louis, Joe
Marciano, Rocky
Olympic Games (table)
Queensberry Rules
Robinson, Sugar Ray
Sullivan, John L.
Tunney, Gene
Tyson, Mike

Outline

I. Boxing regulations
- A. Weight classes
- B. The ring
- C. Equipment
- D. Time periods
- E. Fight officials
- F. Scoring a fight
- G. Fight rules

II. Boxing skills

III. Amateur boxing

IV. Professional boxing
- A. Financing
- B. Regulation

V. History

Questions

What is a *technical knockout?*
What is the Golden Gloves?
What part did John L. Sullivan play in boxing history?
What are the Queensberry Rules?
Why was Muhammad Ali's title taken away in 1967?
What does a promoter do?
What is a *feint?* A *jab?* A *combination?*
Why do some U.S. states use thumbless boxing gloves?
What are the duties of the *referee* and the *judges?*
Why did attendance at boxing matches decline in the 1950's?

Additional resources

Blewett, Bert. *The A-Z of World Boxing.* 1996. Reprint. Robson Bks., 1999.
Fleischer, Nat, and Andre, Sam. *An Illustrated History of Boxing.* 6th ed. Citadel, 2001.
Scott, Danna. *Boxing: A Complete Guide to Training and Fitness.* Perigee, 2000.
Werner, Doug, and Lachica, Alan. *Fighting Fit: Boxing Workouts, Techniques and Sparring.* Tracks Pub., 2000.

Boxing Day is a holiday celebrated in the United Kingdom, Australia, New Zealand, and Canada. It falls on December 26, which is also St. Stephen's Day. The public observance of Boxing Day takes place on the following Monday if December 26 falls on a Saturday or Sunday. The traditional celebration of Boxing Day included giving money and other gifts to charitable institutions, needy individuals, and people in service jobs. The holiday may date from the Middle Ages (about the A.D. 400's through the 1400's), but the exact origin is unknown. It may have begun with the lords and ladies of England, who gave Christmas gifts to their servants on December 26. Or it may have begun with priests, who opened the church's *alms* (charity) boxes on the day after Christmas and distributed the contents to the poor. Jack Santino

Boy Scouts of America

Scout uniforms vary according to the level of the Scouting program. The photograph at the left shows two Cub Scouts in uniform. Webelos Scouts appear in the middle photo. Webelos make up the highest rank in Cub Scouting. The photograph at the right shows two Boy Scouts in uniform.

Boy Scouts

Boy Scouts is an organization that teaches young people to be good citizens and trains them to become leaders. More than 24 million young people and adult leaders belong to Scouting units in more than 130 countries. Scouts are taught to do their duty to God, to their country, and to other people. Their motto is *Be Prepared,* and their method is learning by doing. Scouts practice citizenship by electing their own youth leaders and by learning to work together. As members of the Boy Scouts work and play outdoors, they acquire skills in camping, first aid, outdoor cooking, swimming, and woodcraft.

Universal Scout emblem (United States)

Robert Baden-Powell, a British Army officer, started the Boy Scout movement in 1907, when he organized a camp for 20 boys. Baden-Powell wrote the first Boy Scout manual, *Scouting for Boys* (1908). The Boy Scout movement spread to the United States because of a Good Turn (friendly act) performed for William D. Boyce, an American businessman, in 1909. A British Boy Scout helped Boyce find his way in a London fog. In response to that good deed, Boyce and others founded the Boy Scouts of America in 1910. Today, more than 4 $\frac{1}{2}$ million young people and adults belong to the Boy Scouts of America, also known as the BSA.

This article discusses mainly Boy Scouts in the United States. For information on Scouting in Canada, see the *World Book* article on Scouts Canada.

Boy Scouts of America

Boys from 6 to 20 years of age may become members of the Boy Scouts of America. The Scouting program has three levels: (1) Cub Scouting, (2) Boy Scouting, and (3) Venturing. Young women from 14 to 20 years old may join Venturing. The president of the United States is the honorary BSA president.

There are Scouting units in almost every U.S. city, town, and rural community. A boy who has no group near him may become a Lone Cub Scout or Boy Scout by writing to the National Office in Texas. Spanish-speaking boys may request handbooks and program materials written in Spanish. Boys with disabilities can take part in Boy Scout programs according to their capabilities. Learning for Life is a school-based BSA program for urban children who are not part of a traditional Scouting program. Children from kindergarten through 12th grade may take part in Learning for Life, which teaches values and skills in a classroom setting.

The BSA is financed by the registration fee of each of its members. Other sources of income include the sale of Scouting uniforms and equipment, endowments, and advertisements in BSA publications. The Boy Scouts of America publishes handbooks, magazines, bulletins, and pamphlets related to all phases of its activities. *The Boy Scout Handbook,* first published in 1910 as *The*

Handbook for Boys, is one of the largest-selling books in the United States. It includes materials not only for Scouts but also for people who are interested in outdoor life. The organization also publishes two magazines, *Boys' Life* and *Scouting.*

Cub Scouting, which began in 1930, is a program for boys who are in first through fifth grade or 7 to 10 years old. Cub Scouts prepare to become Boy Scouts. Two to eight Cub Scouts make up a *den.* Each den elects one of its members to be *denner* (boy leader). A den usually meets once a week. Both adult men and women may serve as *den leaders.* A Scout or Venturer called the *den chief* helps den leaders carry out den activities. Each den is part of a Cub Scout *pack* (unit). A pack meets once a month and is led by an adult Cubmaster.

Boys who are in the first grade may join the Tiger Cub program with an adult member of their family. This program stresses fun, activity, and relationships between the boy and the adult, as well as with the Tiger Cub den.

When a boy goes into second grade, he may become a Cub Scout. Cub Scouts learn new skills and activities. They try to be good citizens and good people, and to get along well with other boys. They learn to respect others. Cub Scouts practice doing their best in all activities. They also try to live up to their religious beliefs.

Bobcat is the first rank in Cub Scouting. To earn this rank, a boy must first learn the Cub Scout sign, salute, motto, Promise, and the Law of the Pack. The Cub Scout motto is *Do Your Best.* The Cub Scout Promise is:

I, (name), promise to do my best
To do my duty to God and my country,
To help other people, and
To obey the Law of the Pack.

The Law of the Pack states:

The Cub Scout follows Akela.
The Cub Scout helps the pack go.
The pack helps the Cub Scout grow.
The Cub Scout gives good will.

Wolf, Bear, and Webelos are the next highest ranks of Cub Scouts. A Cub Scout in the second grade works on 12 Wolf achievement tests to earn the Wolf badge. He must become skillful in cooking, swimming, using tools, and other activities. He must know how to show respect for the U.S. flag, to tie knots, and to practice safety. A Cub Scout in the third grade works on 12 Bear achievements to earn the Bear badge. These are similar to the Wolf achievements, but more difficult.

A boy who is in the fourth or fifth grade may join a Webelos den. The name *Webelos* comes from the phrase *We'll Be Loyal Scouts.* According to legend, *Akela* is the chief of the pack. Cub Scouts give the name Akela to any good leader, such as their Cubmaster or den leader. Webelos Scouts work to earn any or all of 20 activity badges in such areas as citizenship, science, and swimming. Webelos Scouts also work to earn the Arrow of Light Award, the highest award of Cub Scouting.

Boy Scouting. Boys who are at least 11 years old but less than 18 may become Boy Scouts. Boys younger than 11 who have completed the fifth grade or earned the Arrow of Light Award may also become Boy Scouts, even if they have not been Cub Scouts. But first they must learn and promise to follow the Scout Oath and the Scout Law. The Scout Oath is:

On my honor, I will do my best
To do my duty to God and my country
And to obey the Scout Law;
To help other people at all times;
To keep myself physically strong,
Mentally awake, and morally straight.

The Scout Law has 12 points. It states that a Scout is trustworthy, loyal, helpful, friendly, courteous, kind, obedient, cheerful, thrifty, brave, clean, and reverent. To advance in Boy Scouts, a boy must be loyal to the ideals of Scouting and must pass various tests of skill and knowledge. The tests, and loyalty to the ideals, help a boy learn self-reliance, resourcefulness, and courage.

Scouts form *patrols* of five to eight boys. Each patrol elects one member as leader and one as assistant leader. Groups of patrols form a *troop,* led by an adult Scoutmaster and one or more adult assistants. Four patrols usually make up a troop.

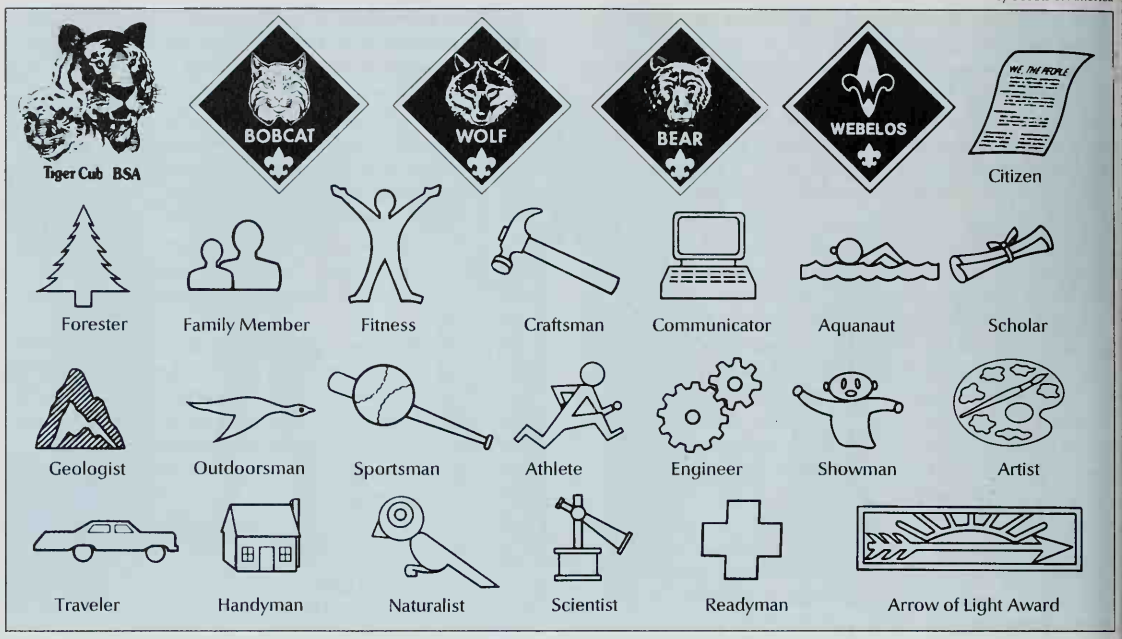
Tenderfoot is the first rank in Boy Scouting. A Tender-

Boy Scouts of America

Cub Scouts work toward becoming Boy Scouts by learning new skills. These skills may include the ability to make model cars like the ones these Cub Scouts are holding.

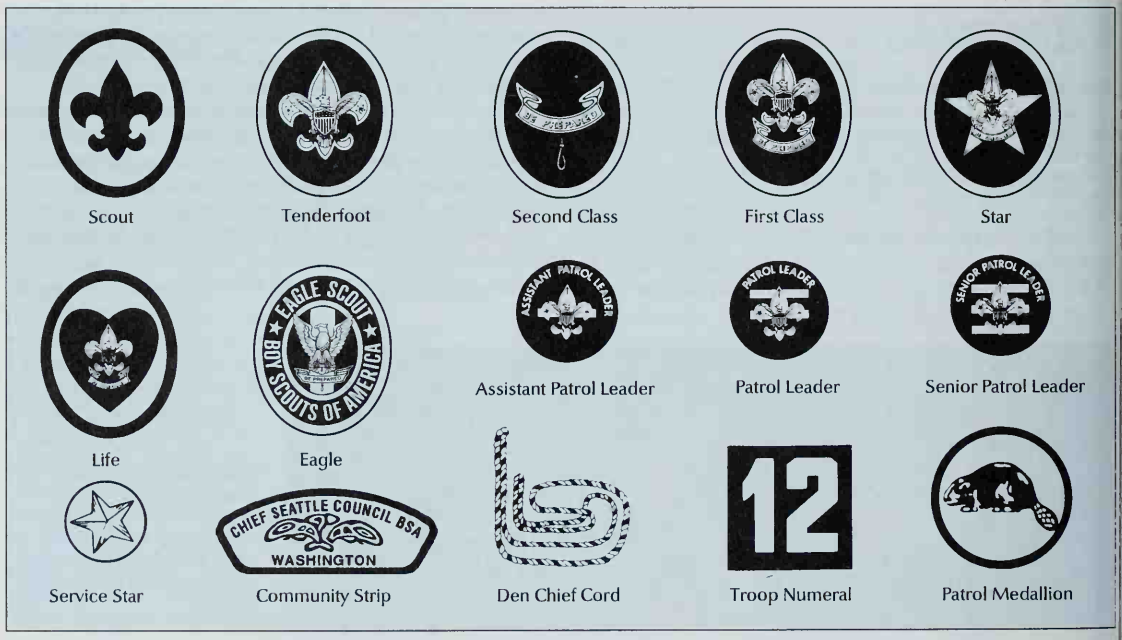
Cub Scout insignia Cub Scouts wear the badges shown here. Five of the badges identify a boy's rank—Tiger Cub, Bobcat, Wolf, Bear, or Webelos. Cub Scouts may also earn up to 20 activity badges and the Arrow of Light Award.

Boy Scouts of America



Boy Scout insignia Boy Scouts wear the insignia pictured here. These are some of the badges that identify a boy's level, patrol, and troop in Scouting. Eagle Scout is the highest rank in Boy Scouting.

Boy Scouts of America



foot must recite the Scout Oath and Scout Law, and show that he follows them. A Tenderfoot must also explain the meaning of each point of the Scout Law in his own words.

A Tenderfoot must have spent one night on a campout and used the proper camping gear. He must have learned simple first aid, such as the *Heimlich maneuver,* a procedure used to stop people from choking. A Tenderfoot must be able to identify poisonous plants and treat someone affected by those plants. Tenderfoot Scouts must know how to present and care for the flag of the United States. They must also have completed other requirements, such as passing a physical fitness test.

Boy Scouts of America

Canoeing is one of many outdoor activities in which Scouts learn to work together. Learning by doing is the method used to teach Scouts many skills.

Finally, a Tenderfoot must have had a personal conference with his Scoutmaster. Such conferences are held each time a boy is ready to advance from one Scout rank to another. In the conferences, the boy and his leader review the Scout's progress and decide what course he should follow to advance to the next rank.

Second Class Scout is the next highest Boy Scouting rank. Second Class Scouts must know how to use a map and compass. They must be able to prepare a cooking fire and cook a meal. In addition, Second Class Scouts need to understand more first aid than Tenderfoot Scouts. Other requirements include passing a swimming test.

First Class Scout is the third rank of Boy Scouting. First Class Scouts must be able to find directions without a compass. They must have served as their patrol's cook on a camp-out. They must also have completed an *orienteering course,* a cross-country hiking race in which the hiker uses a map and compass. A First Class Scout must understand *cardiopulmonary resuscitation* (CPR), a first-aid procedure used to revive a person whose breathing and heartbeat have stopped. Other requirements include passing a more advanced swimming test.

Star Scouts, Life Scouts, and Eagle Scouts. To become a Star Scout, a boy must have been a First Class Scout for at least four months and have earned six merit badges, including four badges required for Eagle Scout. Merit badges are awarded in more than 100 subjects, including communications, emergency preparedness, environmental science, personal fitness, and swimming.

A Life Scout must have been a Star Scout for at least six months. In addition, he must have earned a total of 11 merit badges, including 7 required for Eagle Scout.

To become an Eagle Scout, a boy must have been a Life Scout for at least six months and have earned 12 specifically required merit badges and 9 other merit badges. Star Scouts, Life Scouts, and Eagle Scouts must also meet certain character, service, and leadership requirements. Eagle Scout is the highest rank in Scouting.

Additional awards. Eagle Scouts may gain Eagle Scout Palms by earning more merit badges than the 21 required. They receive a Bronze Palm for 5 additional merit badges, a Gold Palm for 10, and a Silver Palm for 15. Scouts may earn awards for service to their place of worship and for service with local conservation authorities. In addition, they can earn awards for special ability

Boy Scouts of America

Venturers participate in a wide variety of outdoor and hobby activities. Some Venturing groups specialize in a particular interest, such as backpacking or mountain climbing. Both boys and girls who are at least 14 years old may become Venturers.

in camping, and for passing the requirements to become a Lifeguard, BSA. A Scout may be given a Heroism Award for heroic action and an Honor Medal for saving another person's life at the risk of his own. The National Court of Honor grants the Heroism Award and Honor Medal.

Service activities. The Scout slogan is "Do a Good Turn Daily." An important part of Scouting is to respect and care for other people. A troop might do a Good Turn for senior citizens or plan an outing for children with disabilities. Each Scout, to earn the Second Class, Star, and Life ranks, must participate in service projects. To become an Eagle Scout, he must plan and develop a service project and lead other Scouts in carrying it out. Scouts also may take part in conservation projects or collect food for needy families. Scouts have helped during fires, hurricanes, earthquakes, floods, and other emergencies.

Varsity Scouts. Young men from 14 to 18 years old may join a program known as Varsity Scouting. Although the activities of Varsity Scouts are similar to those of other Boy Scouts, they are generally the most difficult and challenging. Varsity Scouts are organized by teams led by an adult Varsity Scout Coach and an elected captain.

Venturing is for young adults of high school age. Venturers share experiences in a wide variety of outdoor and hobby areas. Both boys and girls can become Venturers if they are at least 14 years old and have graduated from eighth grade. Venturers are organized into units called Venturing *crews.* An adult leader supervises the crew and serves as its Advisor. The Advisor is the equivalent of a Boy Scout troop's Scoutmaster. Each crew elects its own officers.

Venturing crews may center their activities on a particular activity or hobby interest. Some crews choose such areas as team sports or scuba diving. Many others take part in mountain climbing, kayaking, backpacking, and other outdoor activities. Crew programs help Venturers develop leadership and citizenship skills. Sea Scouting, a part of Venturing, focuses on boating, navigating, and managing a vessel at sea. Sea Scout units are called *ships.*

Organization. There are over 51,000 Cub Scout packs, 50,000 Boy Scout troops and teams, and 15,000 Venturing crews in the United States. The BSA charters churches, schools, and other community groups and organizations to operate these units. The chartered organizations advise the units and provide meeting places. Each unit has a committee of at least three adults that represents the chartered group. This committee is responsible for unit activities.

More than 300 local BSA councils conduct the Scouting program. These councils keep records on membership and advancement. They provide summer camps, organize expeditions, and conduct leader training courses for adults. The councils are responsible for keeping high standards in the units in their areas. Every organization that operates a Scouting unit sends a representative to the monthly meetings of the local BSA council. Local councils elect officers and executive board members once a year. A Scout executive and a staff of assistants serve each council on a full-time professional basis.

The National Council supervises the BSA movement in the United States. Each local Scouting council sends delegates to a meeting of the National Council held every year. The delegates elect the national executive board, which directs the nationwide BSA program.

Each year, the National Council grants hundreds of awards to men and women for their volunteer services to young people. The highest recognition for such service is the Silver Buffalo Award, presented to United States citizens for exceptional service at the national level. The service may or may not be associated with the Scouting movement. Two related awards are given to adult members of the BSA—the Silver Antelope Award, for outstanding service in a BSA region; and the Silver Beaver Award, for outstanding service in a local BSA council.

The BSA requires that leaders and members live according to the Scout Oath and the Scout Law. This requirement was challenged in 1992, after the BSA dismissed James Dale, a New Jersey Scoutmaster. The BSA claimed that Dale was an avowed homosexual activist. Dale sued, arguing that his dismissal violated New Jersey's Law Against Discrimination. The case eventually went to the Supreme Court of the United States. In 2000, the Supreme Court ruled that because the Boy Scouts were a private organization, they were free to define their own leadership requirements.

Scouting throughout the world

The World Scout Conference is responsible for Scouting on a worldwide basis. Each national Scout organization belongs to the conference, which meets every three years. The conference elects a 12-member World Scout Committee to do its work between meetings.

The World Scout Conference attempts to unify Scouting aims. It admits new member countries, provides for the exchange of ideas, and arranges international meetings and programs. The World Scout Committee established the World Scout Bureau to strengthen national organizations and to spread Scouting worldwide. The bureau's headquarters are located in Geneva, Switzerland.

Jamborees are among the most important Scouting events. At a *national jamboree,* Scouts from all areas of a country spend 7 to 10 days camping together. The Boy Scouts of America held its first national jamboree in July 1937, at the invitation of President Franklin D. Roosevelt. More than 27,000 Scouts and their leaders camped at the foot of the Washington Monument in Washington, D.C.

During *world jamborees,* held every four years, Scouts from all parts of the world meet one another. Jamborees include such events as Scouting demonstrations and pageants that show the clothing, customs, hobbies and crafts, and history of the nations represented. Flags of all the countries fly over the campsite, and groups sing songs from the different lands. The Boy Scouts held their first world jamboree in the United Kingdom in 1920, when 301 Scouts from 32 countries camped together. Today, thousands of Scouts and leaders from countries throughout the world attend world jamborees.

Critically reviewed by the Boy Scouts of America

See also **Baden-Powell, Lord; Girl Guides; Girl Scouts; Low, Juliette Gordon; Scouts Canada.**

Outline

I. Boy Scouts of America
- A. Cub Scouting
- B. Boy Scouting
- C. Venturing
- D. Organization

II. Scouting throughout the world

Questions

Who can join the Boy Scouts of America?
How do Scouts help their communities?
What is the Scout motto?
Who sponsors Scout units?
What is a national jamboree? A world jamboree?
Who is the honorary president of the Boy Scouts of America?
What is the highest Scout rank?
What is a Lone Cub Scout?
How often does the World Scout Conference meet?

Additional resources

Birkby, Robert C. *The Boy Scout Handbook.* 10th ed. 1990. Reprint. Boy Scouts of Am., 1992.
Fieldbook. 3rd ed. 1984. Reprint. Boy Scouts of Am., 1992.
MacDonald, Robert H. *Sons of the Empire: The Frontier and the Boy Scout Movement, 1890-1918.* Univ. of Toronto Pr., 1993.

Boycott is a refusal to deal with an individual, organization, or country. Most boycotts involve the refusal to buy a firm's or nation's products. Such measures are commonly used by labor unions, consumer groups, and countries to force a company or government to change its policies. The word *boycott* comes from the name of Charles C. Boycott, a British land agent of the 1800's. Boycott collected such high rents that his tenants refused to have anything to do with him.

Unions have used boycotts as a way to gain better working conditions for members. There are two main kinds of labor boycotts, *primary* and *secondary.* In a primary boycott, employees refuse to purchase their company's products. Such boycotts are legal but are ineffective in most cases because little of a firm's output is bought by its own workers. In a secondary boycott, striking employees bring pressure on workers in other companies to stop doing business with their employer. The Taft-Hartley Act of 1947 makes secondary boycotts illegal.

Consumer groups use boycotts as an effective form of protest. In 1955 and 1956, blacks in Montgomery, Alabama, boycotted the city bus system, forcing an end to its segregated seating policy. During the 1960's and 1970's, many United States consumers boycotted grapes and lettuce produced by California growers without union contracts. The boycott, led by the United Farm Workers of America, caused the unionization of many farm operators.

Countries have used boycotts for various purposes. For example, the United States and several other countries refused to attend the 1980 Olympic Games in Moscow to protest the Soviet Union's invasion of Afghanistan in 1979. Dora E. Polachek and Solomon W. Polachek

See also **Embargo; Whale** (The future of whales); **Olympic Games** (Boycotts).

Boyd, Belle (1843-1900), was a Confederate spy. She began her career when she shot a Union soldier in her home at Martinsburg, Virginia (now West Virginia). At the age of 17, she became an expert in using secret codes and supplying the Southern armies with information about Northern troop movements.

Northern troops captured and released her three times. She was caught the third time in 1864, on board a ship that was trying to get past the Union blockade. Here she was put in the custody of a young ensign named Sam Wylde Hardinge. He fell in love with her. After her release later that year, they fled to England and were married. Hardinge died soon afterward.

In England, Belle wrote an autobiography called *Belle Boyd in Camp and Prison* (1865), an exciting and appealing account of her adventures. She became an actress in England and returned to the United States, where she gave dramatic lectures on her experiences. She married twice after Hardinge's death. She was born in Martinsburg. John F. Marszalek

Boyle, Robert (1627–1691), an Irish scientist, is considered the founder of modern chemistry. He helped to establish the experimental method in chemistry and physics.

Boyle is best known for his experiments on gases that led to the formulation of Boyle's law (see **Gas** [Gas laws]). This law says the volume of a gas at constant temperature varies inversely to the pressure applied to the gas. Boyle also helped improve the air pump, and with it he investigated the nature of vacuums.

Boyle introduced many new methods for determining the identity and chemical composition of substances. He disproved the theory that air, earth, fire, and water were the basic elements of all matter. Boyle argued that all basic physical properties were due to the motion of atoms, which he called "corpuscles."

Boyle lived in England for most of his life. He was a founding member of the Royal Society of London, one of the world's foremost scientific organizations. Boyle described his experiments in many books. He was born at Lismore Castle, Ireland. Romualdas Sviedrys

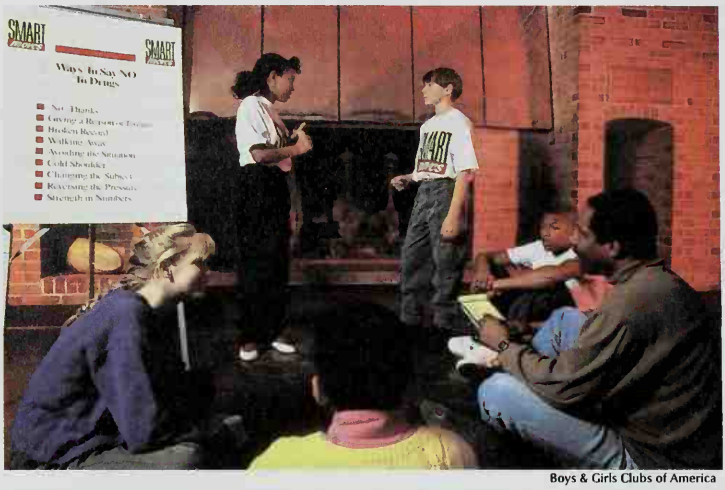
See also **Chemistry** (Alchemy).

Boyne, Battle of the, was the decisive battle in the struggle between former King James II of England and his successor, William III, for the control of Ireland. The battle was fought near the River Boyne, northwest of Dublin.

James II was a Roman Catholic, and the Catholics ruled Ireland during his reign. The English removed James from the throne in 1688, and made William III, a Protestant, king in 1689. James fled to France, and then to Ireland, where he organized an army to fight William. The English defeated James on the banks of the Boyne on July 11, 1690. The war ended with the Treaty of Limerick in 1691. The Battle of the Boyne marked the beginning of Protestant control over Catholics in Ireland. Its anniversary is celebrated by Protestants in Northern Ireland. Charles Carlton

See also **James** (II); **Orange Order; William III.**

Boys & Girls Clubs of America is a nonprofit youth organization that provides support services to local Boys & Girls Clubs and communities throughout the United States. More than 1,200 Boys & Girls Clubs in the United States, Puerto Rico, and the Virgin Islands serve over 1 $\frac{1}{2}$ million young people every day. They form the country's largest network of agencies that focus mainly on youth development for children from disadvantaged backgrounds.



Boys & Girls Clubs of America

BOYS & GIRLS CLUBS OF AMERICA

Boys & Girls Clubs members participate in a variety of programs that encourage personal development. The members at the left are taking part in a program that teaches how to resist pressure from friends to take drugs. The Boys & Girls Clubs emblem, *above,* represents the Clubs' goals of equality and concern for human dignity.

Boys & Girls Clubs provide programs that are designed to give young people the skills they need to become successful adults. Membership dues are kept low so that any young person can belong to a Club.

Activities and organizations. Boys & Girls Clubs offer programs in health and fitness, career exploration, delinquency prevention, and citizenship and leadership development. Local Clubs are started by citizens and civic organizations in communities and neighborhoods where there is a need for after-school and youth development services.

Local boards of directors, made up of volunteers, govern the Boys & Girls Clubs. Local citizens, merchants, and other private organizations help support the Clubs through gifts. The United Way also helps fund some local Clubs (see **United Way of America**).

Boys & Girls Clubs are staffed by full-time professionals and by part-time and volunteer workers. All Clubs have their own building, and most have gymnasiums, libraries, recreation rooms, and vocational workshops. Most Clubs serve inner-city youths. But small cities, towns, and rural communities also have Clubs.

Boys & Girls Clubs of America has five regional offices. Each office has staff members who visit Boys & Girls Clubs and communities to guide and assist with planning and programming. Activities of the national organization include:

(1) Establishing standards of organization, facilities, personnel, programming, and operation for the guidance of individual Clubs.

(2) Furnishing information, advice, and other assistance to Boys & Girls Clubs.

(3) Conducting research, developing resources, and initiating planning.

(4) Aiding in the establishment, improvement, and expansion of Boys & Girls Clubs.

(5) Promoting the Boys & Girls Club Movement.

(6) Representing Clubs in relationships with other organizations and the federal government.

(7) Participating in discussion and planning that affects young people and Boys & Girls Club interests.

(8) Planning and participating in training courses and conferences for professional and volunteer workers.

(9) Making studies of Boys & Girls Clubs on request.

History. The first Clubs were organized in New England in the 1860's. They were established to provide city youths with a safe alternative to the physical and moral dangers of the streets. At that time, there were about 50 Clubs. In 1906, a national organization was formed. In 1956, the U.S. Congress chartered the national organization. The organization was called Boys Clubs of America, though many Clubs allowed girls to join. In 1990, the organization's name was officially changed to Boys & Girls Clubs of America. National headquarters are at 771 First Avenue, New York, NY 10017.

Boys & Girls Clubs of America publishes *CONNECTIONS,* a quarterly magazine. The organization also publishes booklets, books, newsletters, and other materials.

Critically reviewed by the Boys & Girls Clubs of America

Boys' Brigade is an international organization for boys from 6 through 18 years old. It works to develop Christian beliefs among its members through educational, religious, physical, and social activities. The Boys' Brigade is active chiefly in the United Kingdom and about 60 other countries, including Australia, New Zealand, and many nations of Africa.

The Boys' Brigade consists of units called *companies,* each of which is sponsored by a local Christian church. A company may be divided into four sections for boys of various ages. Adult church members give religious instruction and organize such activities as arts and crafts, camping, community service, first aid and safety, music, and sports.

The Boys' Brigade was founded in 1883 in Glasgow, Scotland, by William Alexander Smith, a Scottish merchant. It was one of the world's first uniformed youth organizations. The Boys' Brigade has more than 400,000 members. Its headquarters are in London.

Critically reviewed by the Boys' Brigade

Boys Clubs of America. See **Boys & Girls Clubs of America.**

Boys State is a program of citizenship training of the American Legion. At Boys State meetings, boys learn the responsibilities of citizenship by holding elections and carrying on the business of government. The boys who attend become temporary "citizens" of an imaginary state. They are assigned to counties and cities and are divided into two political parties. The parties are usually

called the Nationalists and the Federalists. The boys carry on an election campaign and elect officers of their state. Then they study the business of government. A boy governor presides over the general assemblies.

The Americanism Commission of the American Legion directs the entire program. The state departments of the Legion hold Boys State meetings each year for boys of high school age. Each state department organizes its own Boys State and usually holds the meetings on a college or university campus. American Legion posts and civic, religious, and educational organizations sponsor the boys. They choose boys who have qualities of leadership to attend the meetings.

The Boys State meetings include health and recreation programs. All the boys have physical examinations and take part in sports. The boys organize orchestras, bands, and glee clubs. Two representatives from each Boys State take part in the American Legion's annual Boys Nation. The Boys Nation meeting trains boys in the functions of the United States government.

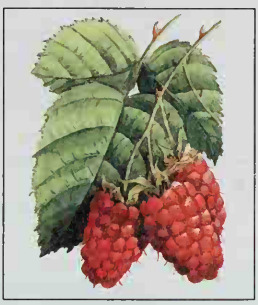
The Illinois department of the American Legion held the first Boys State meeting in 1935. The American Legion convention passed a resolution later that year which approved the Boys State movement. Boys State then became a national project of the Legion's Americanism program. It has headquarters in Indianapolis.

Critically reviewed by the American Legion

See also **Girls State**.

Boys Town. See **Girls and Boys Town**.

Boysenberry, *BOY zuhn BEHR ee,* is a type of blackberry. The tart, juicy, wine-red to almost black fruit grows on a trailing plant. Each boysenberry consists of a cluster of tiny fruits called *drupelets.* The fruit is eaten fresh or is used to make pies, jam, ice cream, and juice.



WORLD BOOK illustration by Kate Lloyd-Jones

Boysenberries

Boysenberries are closely related to loganberries. Both berries are also called *dewberries.* Unlike other types of blackberries, which grow on erect bushes, dewberries develop on long, willowy branches that spread along the ground.

Boysenberries grow best in a mild climate. They may produce crops in colder regions if the plants are protected by snow or an insulating mulch during winter. Growers start new plants by burying sections of roots or stems. As the plants grow, they are tied to stakes or wire frames. New stems sprout yearly, but only two-year-old stems bear fruit. After the boysenberry fruit is harvested, these stems are removed to make room for new growth.

George Pinyuh

Scientific classification. The boysenberry belongs to the genus *Rubus* in the rose family, Rosaceae.

See also **Blackberry; Bramble; Dewberry; Loganberry**.

Bozeman Trail, *BOHZ muhn,* was a route that travelers of the 1860's used to reach gold fields in Montana and Idaho. It covered about 600 miles (970 kilometers) between what are now Fort Laramie, Wyoming, and Virginia City, Montana. The trail was named for John M. Bozeman, who started it in 1863.

People traveling west along the Bozeman Trail headed northwest from Fort Laramie. They crossed the Powder River and traveled along the eastern and northern edges of the Bighorn Mountains. Then they went west across the Bighorn and Yellowstone rivers and through Bozeman Pass. They crossed the Gallatin River and soon turned south to Virginia City. The Sioux Indians fought to close the trail because it crossed their main hunting lands. The Army tried to keep the route open but could not do so, and the trail closed in 1868. In 1877, Texas ranchers began to use it to move their cattle into Montana and Wyoming. W. Turrentine Jackson

See also **Wyoming** (Indian and settler conflicts).

BP is one of the world's largest international oil companies. It was formed as BP Amoco in 1998 when British Petroleum Company merged with Amoco Corporation, a major petroleum company in the United States. The company changed its name to BP p.l.c. in 2001. BP is involved in all stages of the petroleum industry. It searches for and develops new sources of natural gas and oil. The company also refines, markets, and distributes petroleum products. In addition, BP is involved in plastics and other *petrochemicals* (chemicals made from petroleum or natural gas).

Amoco Corporation was founded in 1889 as the Standard Oil Company of Indiana. It was renamed Amoco Corporation in 1957. British Petroleum was formed in 1909 to develop a major oil discovery in Persia (now Iran). This discovery was the first of its kind in the Middle East. Beginning in the late 1960's, British Petroleum became a leading developer of oil and gas fields in other parts of the world, notably Alaska and the North Sea.

BP owns thousands of miles or kilometers of pipelines and tens of thousands of service stations worldwide. It also owns or shares ownership in a number of petroleum refineries. The company is headquartered in London. Critically reviewed by BP

Brace, Charles Loring (1826-1890), an American social reformer, worked to improve the living conditions of poor children. In 1853, he helped organize the Children's Aid Society in New York City and became its head. Brace believed a family could meet the needs of a homeless child better than any institution could. As a result of this belief, the Children's Aid Society sent about 100,000 homeless children from New York City to live with rural families. Largely because of the success of this program, the placement of children in family homes has become an important feature of modern foster care.

Under Brace's leadership, the Children's Aid Society also established lodging houses to provide poor children with a decent place to sleep and founded industrial schools to teach trades and academic subjects. These facilities influenced the growth of modern settlement houses and boys' and girls' clubs. Today, the Children's Aid Society operates camps and community centers that serve about 100,000 New York City children each year.

Brace was born in Litchfield, Connecticut. He graduated from Yale University in 1846. Philip Coltoff

Braces. See **Orthodontics**.

Brachiosaurus, *BRAK ee uh SAWR uhs* or *BRAY kee uh SAWR uhs,* was a gigantic, plant-eating dinosaur that

lived about 150 million years ago in what are now Africa and North America. The name *Brachiosaurus* means *arm lizard.* Unlike most dinosaurs, *Brachiosaurus* had arm bones that were longer than its leg bones. These long arm bones placed the shoulders higher than the hips, and so the body sloped down from the base of the neck to the tail.

Brachiosaurus was about 75 feet (23 meters) long, stood about 40 feet (12 meters) tall, and weighed about 85 short tons (77 metric tons). For many years, *Brachiosaurus* was thought to be the largest and heaviest dinosaur. But scientists have discovered even larger specimens, including *Seismosaurus (SYZ muh SAWR uhs),* which may have grown up to 150 feet (45 meters) long.

Brachiosaurus was a *sauropod,* a large dinosaur with a small head and a long neck and tail. But compared with other sauropods, such as *Apatosaurus, Brachiosaurus* had a longer neck and a shorter, thicker tail. The animal's head featured a broad, flat snout and a large, dome-shaped ridge above the eyes. The nostrils opened from the ridge at the very top of the head.

Brachiosaurus bones found in western North America indicate that the dinosaur lived entirely on dry land. It probably ate leaves from the tops of trees, as giraffes do. Bones were also found near the sea in Tanzania in eastern Africa, where *Brachiosaurus* apparently lived in lowlands near the shore. Peter Dodson

See also **Dinosaur** (picture: When dinosaurs lived).

Bradbury, Ray (1920-), is an American author best known for his fantasy stories and science fiction. Bradbury's best writing effectively combines a lively imagination with a poetic style.

Collections of Bradbury's stories include *The Martian Chronicles* (1950), *The Illustrated Man* (1951), *The October Country* (1955), *I Sing the Body Electric!* (1969), and *Quicker Than the Eye* (1996). His novel *Fahrenheit 451* (1953) describes a society that bans the ownership of books. His other novels include *Dandelion Wine* (1957), a poetic story of a boy's summer in an Illinois town in 1928; and *Something Wicked This Way Comes* (1962), a suspenseful fantasy about a black magic carnival that comes to a Midwestern town. He has also written poetry, screenplays, and stage plays. Ray Douglas Bradbury was born in Waukegan, Illinois. Neil Barron

Braddock, Edward (1695-1755), an English general, led British and colonial troops in a disastrous expedition against Fort Duquesne during the French and Indian War (see **French and Indian wars**). Braddock became commander of the British forces in America in 1754. He planned to capture Fort Duquesne (in present-day Pittsburgh, Pennsylvania) as his first move. Braddock landed at Alexandria, Virginia, in 1755 and assembled a force of some 1,200 men at Fort Cumberland, Maryland. George Washington was a member of Braddock's staff.

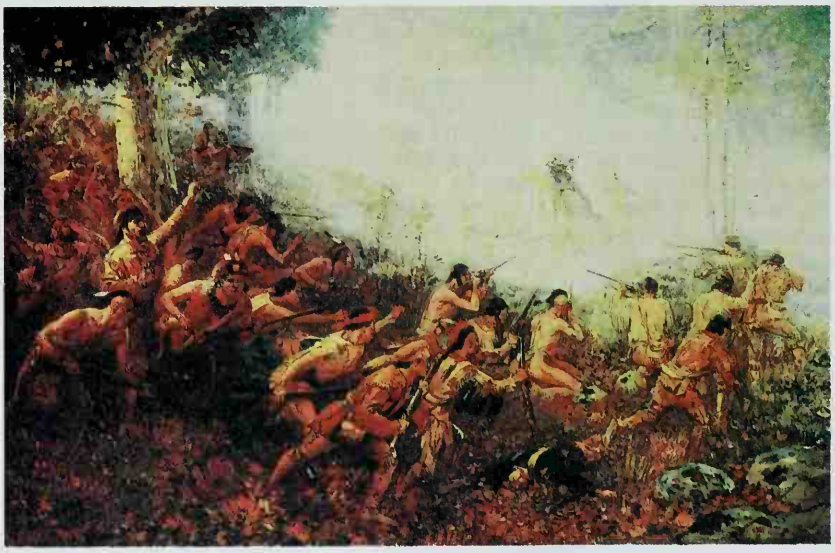
The troops took a path that Washington had marked two years before. Braddock had few Indians to act as scouts. His troops were surprised by 900 French and Indians on July 9, in the woods near Fort Duquesne. The Indians fired into the column for two hours. Then the British soldiers "broke and ran," said Washington, "as sheep before the hounds." Braddock showed great bravery but died of wounds he received. Over half his troops and most of his officers were killed or wounded. Braddock was born in Perthshire, Scotland. John L. Bullion

See also **Franklin, Benjamin** (The Plan of Union).

Braddock, James J. (1905-1974), an American boxer, defeated Max Baer in 1935 to become the world heavyweight champion. His victory, a 15-round decision, ranks as one of the biggest upsets in sports history and earned him the nickname "The Cinderella Man." Braddock was a 10-1 underdog and thought to have little chance to beat Baer. Braddock lost the title to Joe Louis in 1937 in his first defense on an eighth-round knockout. Braddock had knocked Louis down in the first round, only the second boxer to do so. In 1938, after one more fight, Braddock retired with a record of 51 wins and 6 draws in 86 total bouts.

Braddock was born in New York City. He fought his first amateur fight at the age of 17 and turned professional at 19. He was undefeated his first 2 $\frac{1}{2}$ years as a

Braddock's Defeat (1903), an oil painting on canvas by Edwin Willard Deming; State Historical Society of Wisconsin, Madison



Braddock's defeat by French and Indian fighters took place near Fort Duquesne, Pennsylvania, in 1755. Braddock died of wounds received in the battle, and more than half his British and colonial troops were killed or wounded.

professional, often beating heavier opponents. His career began to decline after he lost a light heavyweight title bout to Tommy Loughran in 1929. Braddock gave up boxing in 1933 to work on a shipping dock. In 1934, he returned to boxing, defeating Corn Griffin, a contender for the heavyweight title. Two fights later, Braddock defeated Baer to become the 15th modern heavyweight champion. Bert Randolph Sugar

Braddock's Road extended from Cumberland, Maryland, to Fort Duquesne (now Pittsburgh, Pennsylvania). An army under the British general Edward Braddock built the road in 1755. Braddock's forces needed the road to move military supplies across the Allegheny Mountains during the French and Indian War.

Settlers heading toward Ohio soon followed the same route. Part of this road became the route of the National, or Cumberland, Road (see **National Road**). W. Turrentine Jackson

Bradford (pop. 449,100) is an industrial city in northern England. Bradford and the city of Leeds, about 10 miles (16 kilometers) to the east, form a large urban area (see **England** [political map]). Bradford is an important center of engineering, of the manufacture of textiles and electronics, and of financial industries.

Many buildings in Bradford date from the Victorian period of the 1800's. The city center includes the Victorian-style Wool Exchange, completed in 1867; and the Town Hall, which dates from 1873. Other sites there include the University of Bradford and the National Museum of Photography, Film, and Television. The city is also the home of the Bradford Industrial Museum and the Cartwright Hall art gallery.

The Romans built a camp near what is now Bradford in about A.D. 80, and a town developed at Bradford during the Middle Ages. The town became an important producer of wool textiles. By the 1700's, Bradford was known for its manufacture of worsted wool. The city experienced rapid growth during the 1800's, when the introduction of mechanical weaving greatly increased its textile production. By 1900, Bradford had become the main wool-buying center in its region, handling wool from both home and overseas markets.

Bradford, Roark (1896-1948), was an American author known for his tales about black life in the South. Many of Bradford's stories deal with the folklore of rural African Americans living in Mississippi. Bradford, who was white, has been praised by critics for his skillful use of Southern black speech patterns and slang and his sympathetic humor.

Bradford's first book was the short-story collection *Ol' Man Adam an' His Chillun* (1928). It chiefly consists of black folk interpretations of Old Testament stories. The stories were adapted into the popular religious play *The Green Pastures* (1930) by Bradford's friend, American dramatist Marc Connelly. Bradford's other collections of stories include *Ol' King David an' the Philistine Boys* (1930) and *Let the Band Play Dixie* (1934). His novels include *This Side of Jordan* (1929) and *John Henry* (1931). Bradford was born in Lauderdale County, Tennessee. Samuel Chase Coale

Bradford, William (1590-1657), was the second governor of Plymouth Colony, the settlement established by the Pilgrims in 1620. Bradford served as governor from 1621 to 1657, except for five different years when he was an assistant to the governor. Under his leadership, the colony survived droughts, crop failures, and crippling debt. In 1621, Bradford organized the celebration of the first Thanksgiving Day in New England. His book *Of Plimoth Plantation* is the chief record of Pilgrim life. This book remained in manuscript form for more than 200 years until it was finally published in 1856 as *History of Plymouth Plantation.*

The Pilgrims sailed to America on the *Mayflower* and set up their colony on what is now Plymouth Bay, a part of Cape Cod Bay. Bradford probably helped write the *Mayflower Compact,* a document that set forth the governmental policies of the Pilgrims in the new land (see **Mayflower Compact**). He became governor after the death of the first governor, John Carver.

In 1623, Bradford ended the program that had required the Pilgrims to share the ownership of land, food, and tools. The colony then adopted Bradford's plan of dividing the land and cattle among individual families. This division encouraged the colonists to work harder and to improve their property.

In 1627, Bradford and seven other Pilgrims helped most of the Pilgrims gain financial independence. English merchants had paid the passage to America for the majority of the Pilgrims. But those colonists had not been able to pay their entire debt. Bradford and his group assumed responsibility for the debt and eventually sold some of their own property to help settle it.

Bradford generally maintained peace with the local Indians. In 1637, Plymouth avoided involvement in the Pequot War, in which soldiers from Massachusetts and Connecticut defeated the Pequot Indians of Connecticut.

Bradford was born in Austerfield, England, near Sheffield. As a youth, he joined the Separatists, a group that had left the Church of England, the nation's official church. The Separatists held secret prayer meetings in defiance of King James I. In 1608, Bradford fled to Holland with a band of Separatists in search of religious freedom. Some of the Separatists later sailed to America and became known as the Pilgrims. James Axtell

See also **Pilgrims; Plymouth Colony.**

Additional resources

Bradford, William. *Of Plymouth Plantation: 1620-1647.* Ed. by Samuel Eliot Morison. 1952. Reprint. Knopf, 1987.

Schmidt, Gary D. *William Bradford.* Eerdmans, 1999. Younger readers.

Westbrook, Perry D. *William Bradford.* Twayne, 1978.

Bradford, William (1663-1752), was a printer who played an important role in the beginnings of journalism in the American Colonies. In 1685, Bradford established the first printing press in Philadelphia. In 1692, Bradford was arrested for publishing attacks by Quaker leader George Keith against the main branch of Quakerism. In these attacks, Keith accused the Quaker majority of heresy and lack of discipline. Bradford successfully defended himself before a jury in one of the first trials in the colonies concerning freedom of the press. In 1693, Bradford moved to New York and set up that colony's first printing press. In 1725, he started New York's first newspaper, the *New-York Gazette.*

Bradford was born in Leicestershire, England. His grandson William Bradford III published a leading colonial newspaper, the *Pennsylvania Journal, or Weekly Advertiser,* from 1742 to 1778. Richard D. Brown

Bradford, William, III (1722-1791), was an American publisher and a leading patriot during the Revolutionary War in America (1775-1783). He published a newspaper called the *Pennsylvania Journal,* or *Weekly Advertiser* in Philadelphia from 1742 to 1778. The *Journal* helped lead opposition to the Stamp Act, which Britain had imposed on its American Colonies in 1765 (see **Stamp Act**). Beginning in 1776, Bradford published a series of pamphlets by Thomas Paine called *The American Crisis.* These pamphlets urged the colonists to continue fighting for independence from Britain. Bradford was born in New York City. His grandfather William Bradford was a leading colonial printer. Richard D. Brown

Bradley, Bill (1943-), a New Jersey Democrat, served in the United States Senate from 1979 to 1997. He did not run for reelection in 1996. In the Senate, Bradley was a leading supporter of tax reform. He first gained fame as an outstanding basketball player. In 1999, Bradley began campaigning for the 2000 Democratic presidential nomination, but he dropped out of the race in early 2000.

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Bill Bradley

William Warren Bradley was born in Crystal City, Missouri. He won all-America honors in basketball at Princeton University. After graduating from Princeton, he accepted a Rhodes Scholarship to Oxford University in England. Bradley began a professional basketball career in 1967 with the New York Knickerbockers of the National Basketball Association (NBA) as a forward. He retired from basketball in 1977.

As a U.S. senator, Bradley drew national attention for coauthoring the Bradley-Gephardt "fair tax" bill, which called for fewer income tax brackets and elimination of most tax deductions. These concepts were incorporated into the Tax Reform Act of 1986. Bradley also strongly supported the U.S. Strategic Petroleum Reserve, an oil stockpile designed to prevent future U.S. oil shortages. Guy Halverson

Bradley, Francis Herbert (1846-1924), was a British idealistic philosopher. His chief work, *Appearance and Reality* (1893), outlined his idea that reality is essentially a suprapersonal Being, or Absolute. He believed reality can best be described as a harmonious whole, in which all the contradictions of personal experience are overcome. It cannot be known by rational analysis, but, by analogy, can be vaguely distinguished from human experience. Bradley's version of absolute idealism is a controversial adoption of the philosophy of the German philosopher G. W. F. Hegel. Bradley was born at Glasbury, in Wales. Stephen A. Erickson

Bradley, James (1693-1762), was an English astronomer. His extraordinary talent for precise observation led him to two great discoveries, the aberration of light and the *nutation* (nodding motion) of the earth's axis (see **Aberration**). Bradley was born at Sherbourne, Gloucestershire. He was a professor of astronomy at Oxford University, England's Astronomer Royal, and director of the Royal Greenwich Observatory. Michael J. Crowe

Bradley, Omar Nelson (1893-1981), commanded the largest fighting force ever amassed in battle under the American flag. His troops swept through France, Belgium, the Netherlands, Germany, Austria, and Czechoslovakia during World War II (1939-1945). Bradley's Twelfth Army Group consisted of the United States First, Third, Ninth, and Fifteenth armies—about 1 million men, organized in over 40 combat divisions. Bradley's brilliant military leadership and concern for his men made him one of the most popular wartime generals.

Bradley was born in Clark, Missouri. In August 1911, he entered the United States Military Academy and began a career of over 69 years in the Army. He remained on active duty until his death.

Bradley graduated from the academy in 1915. He served at several Army posts in the United States during World War I (1914-1918), and advanced to the rank of major. In World War II, he succeeded General George S. Patton as commander of the Second Army Corps in the Tunisian campaign, and later led this unit in the Sicilian campaign. He then took command of U.S. ground forces for the invasion of France. He commanded the Twelfth Army Group in France from August 1944 until the war's end. Bradley had a policy of keeping his command post near the front lines and visiting the front.

In 1948, Bradley became chief of staff of the U.S. Army. He served as the first chairman of the Joint Chiefs of Staff from 1949 to 1953. Also during those years, he was on the Military Committee of the North Atlantic Treaty Organization (NATO). Bradley became a General of the Army in 1950. His book *A Soldier's Story* (1951) relates his World War II experiences. Maurice Matloff

Bradley, Thomas (1917-1998), was the first African-American mayor of Los Angeles. He was mayor from 1973 to 1993. In 1973, Bradley defeated Mayor Sam Yorty and became leader of what was then the third largest U.S. city. African Americans made up about 18 percent of the city's population in 1973, but Bradley won over 56 percent of the total vote. He was re-elected in 1977, 1981, 1985, and 1989 and was the only person ever elected mayor of Los Angeles more than three times. A large majority of black voters supported him in all five elections, but he also got support from whites. Bradley ran for governor of California in 1982 and 1986, losing both times.

Office of the Mayor

Thomas Bradley

Bradley, a sharecropper's son, was born in Calvert, Texas. He graduated from the University of California at Los Angeles in 1940. He served on the Los Angeles police force for 21 years, studying law at night. In 1961, Bradley retired as a lieutenant and began to practice law. He served on the Los Angeles city council from 1963 until he became mayor. In 1984, Bradley received the Spingarn Medal for his work in law and for his public and political leadership. In 1993, Bradley declined to seek a sixth term as mayor of Los Angeles. He returned

to practicing law after stepping down as mayor.
Alton Hornsby, Jr.

Bradstreet, Anne (1612?-1672), was the first important American poet. She is best known for *The Tenth Muse Lately Sprung Up in America,* a collection of her poems. This work was the first volume of original poetry written in the American Colonies. It was published in London in 1650. Many of the poems in *The Tenth Muse* deal with science and with Bradstreet's moral and religious ideas. However, her best poems describe home life in colonial New England. They include "Contemplations" and "On the Burning of Her House." Bradstreet also wrote sensitive poetry to her husband and children, including "To My Dear and Loving Husband" and "Meditations Divine and Moral."

Anne Dudley probably was born in Northampton, England. She married Simon Bradstreet when she was 16 years old. They settled in the Massachusetts Bay Colony in 1630. Edward W. Clark

Brady, Diamond Jim (1856-1917), was an American businessman famous for his extravagant lifestyle. His real name was James Buchanan Brady, but he was called Diamond Jim because of his lavish collection of diamond jewelry.

Brady was born on Aug. 12, 1856, in New York City. As a young man, he worked as a bellhop and held jobs with railroads and machinery manufacturers. He made a fortune in the late 1880's selling railroad cars for the Fox Pressed Steel Car Company. He later served as director of the Standard Steel Car Company and other firms.

Brady became a New York celebrity. Newspapers described the nightly rounds he made of Broadway theaters and nightclubs accompanied by actresses and showgirls. He wore a different set of precious gems for each day of the week, and he once bought his dog eyeglasses that were decorated with diamonds. Brady entertained lavishly and gave generous gifts to his friends.

In 1912, Brady donated money to establish the James Buchanan Brady Urological Institute, a center for the study of urinary problems at Johns Hopkins University in Baltimore, Maryland. He also gave a large sum to the New York Hospital (now the New York Hospital—Cornell Medical Center) in New York City to endow its Brady Urological Division. He willed much of his estate to the institute and the hospital. Lewis L. Gould

Brady, Mathew B. (1823?-1896), was a famous American photographer. He is recognized as one of the first great photographers of American historical subjects. Brady's pictures provide the only visual record of many leading people and events of the 1800's. When the Civil War began in 1861, Brady felt the conflict must be photographed as completely as possible. He hired up to 100 cameramen, who took thousands of pictures, including battlefield scenes and scenes of army camp life.

Brady was born in Warren County, New York, and moved to New York City about 1840. He opened a studio there in 1844 to produce a type of early photo called a *daguerreotype* (see **Daguerreotype**). By 1851, Brady's eyesight had grown too poor for him to operate a camera. His name became a symbol of his business rather than a claim that the work was his. A number of Brady's pictures won prizes, though many were made by people who worked in his studios. Richard Rudisill

For examples of Brady staff photography, see **Photography** (History); **Grant, Ulysses S.** (As a Civil War general); **Barton, Clara; Civil War** (Abraham Lincoln; Ulysses S. Grant; Magazine illustrators); **Davis, Jefferson; Douglas, Stephen A.; Meade, George G.; White House.**

Additional resources

Panzer, Mary, and others. *Mathew Brady and the Image of History.* Smithsonian Institution, 1997.
Sullivan, George. *Mathew Brady.* Cobblehill, 1994.

Brady, Nicholas Frederick (1930-), was United States secretary of the treasury from 1988 to 1993. He was appointed by President Ronald Reagan and remained in the post under President George H. W. Bush. Before becoming secretary, Brady had served on many special federal task forces. These bodies included the Presidential Task Force on Market Mechanisms, also called the "Brady Commission." President Reagan set up the task force in 1987 to examine certain Wall Street practices after the stock market crash of that year.

Brady was born on April 11, 1930, in New York City. He received a bachelor's degree from Yale University in 1952 and earned a master's degree in business administration from Harvard University in 1954. Also in 1954, Brady joined Dillon, Read & Company, a New York investment banking firm. He became chairman of its board of directors in 1974. Brady served in the U.S. Senate in 1982. He was appointed to complete the term of New Jersey Senator Harrison Williams, who had resigned. Lee Thornton

Braga, *BRAH guh* (pop. 86,316), is a city in northwestern Portugal. It lies in an area of fertile farmland (see **Portugal** [political map]). The city is a center of Roman Catholicism and has several important churches and schools of religion. Braga produces famous unaged wines called *vinhos verdes.* Its other products include hats, knives, religious mementos, and textiles. Tourists visit Braga's churches and the shrine of Bom Jesus do Monte. In ancient times, Braga was an important Roman settlement. In 1926, military officers began a revolution in Braga that overthrew Portugal's first republic and established a dictatorship. Douglas L. Wheeler

Bragg, Braxton (1817-1876), was a Confederate general during the Civil War. He took command of the

Library of Congress

Mathew B. Brady traveled with the Union Army to take pictures of the battles, camps, and soldiers during the Civil War.

Southern forces at Pensacola, Florida, in 1861. Bragg commanded a corps of Southern troops in the Battle of Shiloh and later commanded the Confederate Army of Tennessee. Bragg retreated after battles at Perryville and Murfreesboro (Stones River). In September 1863, he defeated General William S. Rosecrans at Chickamauga, but General Ulysses S. Grant defeated him later at Missionary Ridge. Bragg then served as military adviser to Confederate President Jefferson Davis. He was born at Warrenton, North Carolina, and graduated from the U.S. Military Academy in 1837. He became a general in 1862. See also **Fort Bragg.** Steven E. Woodworth

Bragg, Sir William Henry (1862-1942), was a British physicist. He and his son, Sir William Lawrence Bragg, shared the 1915 Nobel Prize in physics for their use of X rays to study the structure of crystals. By analyzing how the paths of X rays change as the rays pass through crystals, the two scientists determined the detailed arrangement of atoms within crystals. Their technique has become a fundamental part of molecular biology.

William Henry Bragg was born near Wigton, in what is now the county of Cumbria, and studied at Cambridge University in England. He served as a professor at the universities of Adelaide (Australia), Leeds, and London. Bragg later became director of the Royal Institution in London. Bruce R. Wheaton

See **Crystal; X rays** (In crystal research).

Brahe, *brah* or *BRAH hee,* **Tycho,** *TEE koh* (1546-1601), was a Danish astronomer. Brahe developed a systematic approach for observing the planets and stars. He stressed the importance of making such observations on a regular basis. The telescope had not yet been invented, and so Brahe used his eyesight and such instruments as astrolabes and quadrants to estimate the positions of celestial objects. His observations were far more precise than those of any earlier astronomer.

Brahe's observations of planetary motion revealed that the tables then in use to predict the positions of the planets were inaccurate. His sighting of a *supernova* (type of exploding star) in 1572 helped disprove the ancient idea that no change could occur in the heavens beyond the orbit of the moon.

Like many astronomers of his time, Brahe refused to accept the Copernican theory of the solar system. According to this theory, the earth and the other planets move around the sun. Brahe reasoned that if the earth revolved around the sun, he should have been able to measure changes in the positions of the stars resulting from the earth's movement. He did not realize that such changes were too small for his instruments to detect. However, Brahe's observational data later enabled Johannes Kepler, a German astronomer and mathematician, to confirm the Copernican theory.

Brahe was born in Knudstrup (then a Danish city but now in Sweden), near Malmö. As a member of the nobility, he attended universities in Denmark, Germany, and Switzerland. Brahe built an elaborate observatory on the island of Hven (now called Ven), where he made many of his observations. Raymond E. White

See also **Astronomy** (History; picture: Tycho Brahe's observatory).

Brahman, *BRAH muhn,* is the name of the most absolute, abstract form of God in the Hindu religion. Hindus believe Brahman is the divine force that sustains the universe. Brahman assumes three main forms, called the *Trimurti.* They are *Brahma,* the creator of the universe; *Vishnu,* its preserver; and *Shiva,* its destroyer.

Hindus relate Brahman to the idea of *Atman,* the universal soul that is the source of individual souls. Many Hindus believe people must discover the Atman or Brahman in themselves to achieve spiritual perfection.

In the *Rigveda,* the earliest Hindu scriptures, the name Brahman referred to the power present in religious sacrifices. As Hindu philosophy developed, this power came to mean the soul of the universe. Parts of the *Upanishads,* a group of sacred writings, glorify Brahman over all other forms of God. Charles S. J. White

See also **Vishnu; Shiva; Upanishads; Hinduism.**

Brahmaputra River, *BRAH muh POO truh,* is an important waterway of southern Asia. It rises on the northern slopes of the Himalaya in Tibet. After flowing 1,680 miles (2,704 kilometers) through India and Bangladesh, it joins the Ganges River, with which it shares the Ganges Delta. The northern part of the river has many names. It is sometimes called Yarlung Zangbo in Tibet.

Boats can sail up the river about 800 miles (1,300 kilometers) but cannot go farther because of rapids. A bridge erected in 1963 crosses the river near Gauhati, in the state of Assam in India.

The valley of the Brahmaputra, in Assam, has fertile farmland. Large crops of tea, rice, and jute grow there. In rainy seasons, the river floods much of the valley, providing natural irrigation for rice growers. The principal branches of the Brahmaputra are the Lohit, Dibong, Dihong, and Subansiri rivers. H. J. McPherson

Brahms, Johannes, *yoh HAH nuhs* (1833-1897), was one of the greatest composers of the late 1800's. Brahms's most important works include four symphonies, two piano concertos, one violin concerto, a requiem, chamber music, piano music, and solo songs with piano accompaniment. His music reflects many traits of the romantic movement while it is organized into elements of classical order (see **Romanticism**).

His life. Brahms was born in Hamburg, Germany. He studied piano as a child and showed great talent. He soon began to compose and arrange music. He gave his first solo piano recital in 1848.

Brahms performed with other musicians in many recitals. Among these musicians were the prominent violinists Eduard Reményi and Joseph Joachim. Through Joachim, Brahms met the composers Franz Lizst and Robert Schumann. He developed a good relationship with Schumann and Schumann's wife, Clara, who was herself a piano virtuoso and composer. Brahms's compositional style was greatly influenced by that of Robert Schumann.

From 1857 to 1859, Brahms worked from time to time at the small court of Detmold as a pianist, composer, and conductor of the court choir. He spent the rest of his time in Hamburg. In Hamburg, he founded a women's chorus, for which he com-

Austrian Information Service

Johannes Brahms

posed and arranged a number of works. He moved to Vienna in 1862. In 1863, Brahms became director of the Vienna Singakademie, a choral organization. He held the directorship for one year. Brahms often left Vienna on concert tours as a solo pianist or as an accompanist to other prominent performers. He performed in most of the countries of Europe, and he became well known throughout the continent.

In 1872, Brahms became the director of the Vienna Gesellschaft der Musikfreunde (Society for the Friends of Music). He left the position in 1875 to devote more time to composing. During the following years, Brahms was very productive as a composer. He continued to give many recitals.

Beginning in 1881, Brahms used the fine orchestra at the court of Meiningen to try out his new compositions. As his fame grew, he continued to perform frequently as a pianist and as a guest conductor. In 1890, Brahms decided to stop composing, and he discarded several incomplete works. But in 1891, after hearing and meeting the clarinet virtuoso Richard Mühlfeld, he quickly composed two major works featuring the clarinet.

His music. Brahms composed in most of the forms of music that were common in his time. These included piano music, instrumental chamber music, orchestral music, concertos, songs, and choral works. Brahms composed no ballets, masses, or operas.

Brahms created many works for solo piano, including ballads, capriccios, fantasias, intermezzos, scherzos, sonatas, and variations. His *Variations and a Fugue on a Theme by Handel* (1861) is one of his masterpieces for solo piano. He also wrote works for two pianos.

Brahms's chamber music includes several sonatas for piano and another instrument, as well as trios, quartets, quintets, and sextets. He also composed 11 chorale preludes for organ.

The composer's orchestral music includes two serenades (both 1860) and four symphonies (1876, 1877, 1883, and 1885). His *Variations on a Theme by Haydn* (1873) is one of his most appealing and expertly crafted works. The *Tragic Overture* (1880) and the *Academic Festival Overture* (1881) are two important shorter orchestral works.

Brahms's concertos were significant additions to the concerto repertoire of the late 1800's. They include the first (1859) and second (1881) piano concertos, the Violin Concerto (1879), and the Double Concerto (1887) for violin and cello.

The vocal works of Brahms include more than 200 songs and many duets and quartets. Especially popular are the two sets of *Liebeslieder* (love songs) quartets. Brahms's numerous unaccompanied choral works include motets, *part songs* (songs for several voices), and arrangements of folk songs. Significant choral works with accompaniment include *A German Requiem* (1869) for soprano and baritone soloists, chorus, and orchestra; and the Alto Rhapsody (1870) for solo contralto, male chorus, and orchestra.

Brahms had a very personal and unique musical style. He used traditional musical forms in innovative ways. He filled his music with fresh melodies and harmonies. His melodies were often intensely lyrical.

Brahms's musical style reflects his interest in the music of earlier times. He collected a large library of music and theoretical writing of the 1700's and earlier. Brahms was in frequent contact with prominent music historians. He also collaborated with Clara Schumann and others to prepare an edition of the music of Robert Schumann. Daniel T. Politoske

Additional resources

Botstein, Leon, ed. *The Compleat Brahms.* Norton, 1999.
Brahms, Johannes. *Johannes Brahms: Life and Letters.* Ed. by Styra Avins. Oxford, 1997.
Musgrave, Michael. *A Brahms Reader.* Yale, 2000.
Swafford, Jan. *Johannes Brahms.* 1997. Reprint. Vintage, 1999.

Braiding is one of the simplest methods of interlacing yarn or other fibers. A person using this technique braids three or more fibers by passing each one diagonally over and under one or more of the others.

Braided material is sometimes used as decorative trim on clothing. Such trim consists of a single piece of braid because braid ends cannot be neatly joined. Today, most decorative braid is made by special machines and machine attachments.

During the 1800's, women enjoyed stitching gold, silk, or wool braid to fabric as a form of decoration. This type of decoration was faster and less tedious to create than certain types of embroidery. Later, *soutache* braid became popular. This braid can be sewn loosely in place by hand and then machine stitched.

Today, people use braiding techniques to make a wide range of products. These products include shaped articles, such as straw hats and small rugs; narrow fabrics, such as ribbons for women's hats; cords and tapes, including wicks, shoelaces, and fishlines; and cord coverings for tires, tubing, wires, and cables. Patrick H. Ela

Cylinder Form (1985) by Ken Carlson (American Craft Council)

A braided vessel was made by a craftworker who interlaced strips of leather over and under one another.

WORLD BOOK photo by Cameramann International, Ltd.

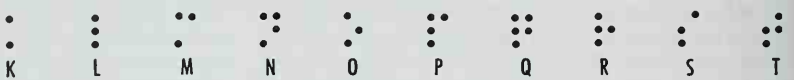
A braille book has words printed as a series of raised dots. Blind people read by running their fingertips over the dots. Each braille page has dots stamped on both sides of the paper.

Illinois Visually Handicapped Institute (WORLD BOOK photo)

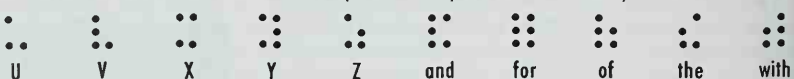
A braille printer, *foreground,* can be attached to a word-processing system. A voice-activated dictaphone, on top of the computer, dictates information for this blind woman to type.

The braille cell is three dots high and two dots wide. This means that 63 different characters can be formed.

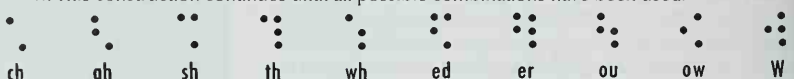
The braille alphabet starts by using 10 combinations of the top 4 dots. The same 10 characters, when preceded by a special number sign, are used to express the numbers 1 to 0.



Adding the lower left-hand dot makes the next 10 letters. Adding the lower right-hand dot makes the last five letters of the alphabet (except *w*) and five word symbols, *shown here.*



Omitting the lower left-hand dot forms nine *digraphs,* or speech sounds, and the letter *w.* This construction continues until all possible combinations have been used.



Braille, *brayl,* is a code of small, raised dots on paper that can be read by touch. Louis Braille, a 15-year-old blind French student, developed a raised dot reading system in 1824. The idea came to him from the dot code punched on cardboard that Captain Charles Barbier used to send messages to his soldiers at night.

In 1829, Braille published a dot system, basing it on a "cell" of six dots. From the 63 possible arrangements of the dots, Braille worked out an alphabet, punctuation marks, numerals, and, later, a system for writing music. His code was not officially accepted at once. But later it won universal acceptance for all written languages and for mathematics, science, and computer notation.

Blind people read braille by running their fingers along on the dots. They can write braille on a 6-key machine called a *braillewriter,* or with a stylus on a pocket-size metal or plastic slate.

Braille books are pressed from metal plates. The characters are stamped on both sides of the paper by a method called *interpointing.* Dots on one side of the page do not interfere with those printed on the other. In the early 1960's, publishers began using computers to speed up production of braille books. The text is typed into a computer that automatically translates it into braille. The computer then transfers the raised braille figures onto paper or onto metal plates for use in a press. By another method, a *vacuum braille former* duplicates hand-transcribed braille pages on plastic sheets, which are then bound in volumes.

Kenneth A. Stuckey

See also **American Printing House for the Blind; Library** (State libraries).

Additional resources

Freedman, Russell. *Out of Darkness: The Story of Louis Braille.* Clarion, 1997. Younger readers.

Lowenfeld, Berthold, and others, eds. *Blind Children Learn to Read.* C. C. Thomas, 1974.

Braille, *brayl,* Louis (1809-1852), was a blind Frenchman who invented the braille system of printing and writing for the blind. He was born near Paris. An accident at age 3 followed by a serious infection left him blind. He entered the Royal Institution for Blind Youth in Paris (now the National Institution for Blind Youth) when he was 10. Braille was a good student, especially of science and music, and he became a church organist. He remained at the Institute as a teacher. There he developed his system of reading. It utilizes raised dots on paper for letters. See **Braille.** Kenneth A. Stuckey

Brain

Brain is the master control center of the body. The brain constantly receives information from the senses about conditions both inside the body and outside it. The brain rapidly analyzes this information and then sends out messages that control body functions and actions. The brain also stores information from past experience, which makes learning and remembering possible. In addition, the brain is the source of thoughts, moods, and emotions.

In such simple animals as worms and insects, the brain consists of small groups of nerve cells. All animals with a backbone have a complicated brain made up of many parts. Animals that have an exceptionally well developed brain include apes, dolphins, and whales. Human beings have the most highly developed brain of all. It consists of billions of interconnected cells and enables people to use language, solve difficult problems, and create works of art.

The human brain is a grayish-pink, jellylike ball with many ridges and grooves on its surface. A newborn baby's brain weighs less than 1 pound (0.5 kilogram). By the time a person is 6 years old, the brain has reached its full weight of about 3 pounds (1.4 kilograms). Most of the brain's nerve cells are present at birth. The increase in weight comes mostly from the growth of nerve cells, development and growth of supporting cells, and development of connections among cells. During this six-year period, a person learns and acquires new behavior patterns at the fastest rate in life.

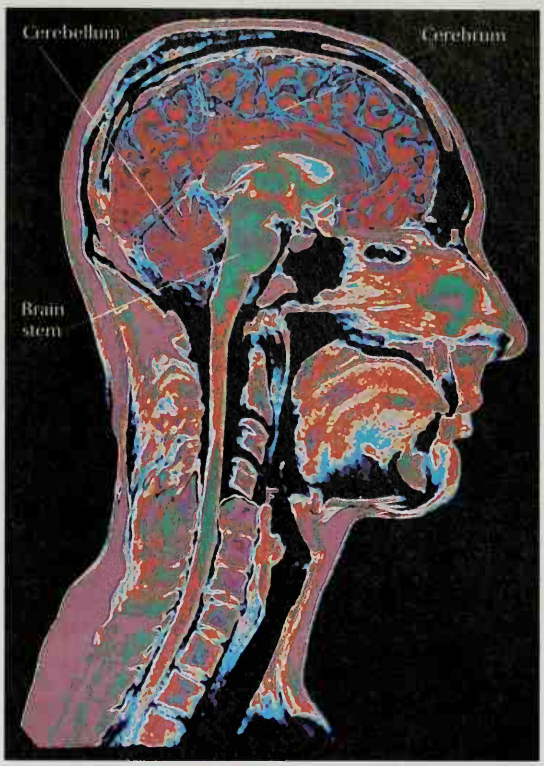
A network of blood vessels supplies the brain with the vast quantities of oxygen and food that it requires. The human brain makes up only about 2 percent of the total body weight, but it uses about 20 percent of the oxygen used by the entire body when at rest. The brain can go without oxygen for only three to five minutes before serious damage results.

The brain is at the upper end of the spinal cord. The spinal cord is a cable of nerve cells that extends from the neck about two-thirds of the way down the backbone. The spinal cord carries messages between the brain and other parts of the body. In addition, 12 pairs of nerves connect the brain directly with certain parts of the body. For more information about the nervous system and the brain's place in it, see **Nervous system.**

The brain works in some ways like both a computer and a chemical factory. Brain cells produce electrical signals and send them from cell to cell along pathways called *circuits.* As in a computer, these circuits receive, process, store, and retrieve information. Unlike a computer, however, the brain creates its electrical signals by chemical means. The proper functioning of the brain depends on many complicated chemical substances produced by brain cells.

Scientists in various fields work together to study the structure, function, and chemical composition of the brain. This field of study, called *neuroscience* or

Richard Restak, the contributor of this article, is Clinical Professor of Neurology at George Washington University Medical School and the author of The Brain *and* Brainscapes.



© Dan McCoy, Rainbow

The structure of the human brain is revealed in remarkable detail by magnetic resonance imaging (MRI). This image through the center of the head shows the brain's three main regions—the cerebrum, the cerebellum, and the brain stem.

Interesting facts about the brain

During the embryonic period of human development, the brain is formed and develops much more quickly than other internal organs or limbs.

Your brain had reached its full weight of about 3 pounds (1.4 kilograms) by the time you were 6 years old.

The left side of your brain controls movements on the right side of your body, and the right side of your brain controls movements on the left side of your body.

Chimpanzees have the largest brains, in relation to their body weight, of any animals except for human beings.

The brain does not feel pain directly because it has no pain receptors. As a result, doctors can perform some types of brain surgery on patients who are conscious.

Brain cells begin to die if they are deprived of oxygen for three to five minutes.

A study of German-born physicist Albert Einstein's brain revealed that while the overall size was average, a portion of his brain related to mathematical ability was about 15 percent larger than average. Scientists think this key difference may explain the great physicist's genius.

Scientists do not completely understand why people dream. They think dreaming may help the brain restore its ability to focus attention, to remember, and to learn.

The brain requires about 20 percent of the body's oxygen supply though it makes up only about 2 percent of a person's total body weight.

Your brain is as individual as your face. Everyone's brain has the same physical features, but no brain looks exactly like any other brain.

neurobiology, is rapidly increasing our understanding of the brain. But much remains to be learned. Scientists do not yet know how physical and chemical processes in the brain produce much of the brain's activity.

This article deals chiefly with the human brain. The last section of the article briefly discusses the brain in various kinds of animals.

The parts of the brain

The brain has three main divisions: (1) the cerebrum, (2) the cerebellum, and (3) the brain stem. Each part consists chiefly of nerve cells, called *neurons,* and supporting cells, called *glia.*

The cerebrum makes up about 85 percent of the weight of the human brain. A large groove called the *longitudinal fissure* divides the cerebrum into halves called the *left cerebral hemisphere* and the *right cerebral hemisphere.* The hemispheres are connected by bundles of nerve fibers, the largest of which is the *corpus callosum.* Each hemisphere, in turn, is divided into four *lobes* (regions). Each lobe has the same name as the bone of the skull that lies above it. The lobes are (1) the frontal lobe, at the front; (2) the temporal lobe, at the lower side; (3) the parietal lobe, in the middle; and (4) the occipital lobe, at the rear. Fissures in the cerebral cortex form the boundaries between the lobes. The two major fissures are the *central fissure* and the *lateral fissure.*

A thin layer of nerve cell bodies called the *cerebral cortex* or *cortex* forms the outermost part of the cerebrum. Most of the cerebrum beneath the cortex consists of nerve cell fibers. Some of these fibers connect parts of the cortex. Others link the cortex with the cerebellum, brain stem, and spinal cord.

The cerebral cortex is folded into a surface with many ridges and grooves. This folding greatly increases the surface area of the cortex and the number of nerve cells it contains within the limited space of the skull. Some areas of the cortex, called the *sensory cortex,* receive messages from the sense organs as well as messages of touch and temperature from throughout the body. Areas in the frontal lobes called the *motor cortex* send out nerve impulses that control the voluntary movements of all the skeletal muscles. The largest portion of the cortex is the *association cortex.* Every lobe of the brain has areas of association cortex that analyze, process, and store information. These association areas make possible all our higher mental abilities, such as thinking, speaking, and remembering.

The cerebellum is the part of the brain most responsible for balance, posture, and the coordination of

Brain terms

Association cortex is any part of the cortex where information is analyzed, processed, or stored.

Axon, *AK sahn,* is the long extension of a neuron that carries nerve impulses away from the body of the cell.

Basal ganglia, *BAY suhl GANG glee uh,* are groups of neurons at the base of the cerebrum. They help control well-learned movement sequences such as walking.

Brain stem is the lowest part of the brain, connecting the spinal cord with the cerebrum.

Cerebellum, *SEHR uh BEHL uhm,* is the part of the brain below the back of the cerebrum that regulates balance and movement and coordinates the muscles.

Cerebral hemisphere is either the left or right side of the cerebrum, the main portion of the brain.

Cerebrum, *SEHR uh bruhm* or *suh REE bruhm,* is the largest and most complex portion of the brain. It controls thought and learning.

Corpus callosum, *KAWR puhs kuh LOH suhm,* is the largest bundle of nerve fibers connecting the left and right cerebral hemispheres.

Cortex is a deeply folded and ridged layer of neurons on the surface of the cerebrum.

Dendrite, *DEHN dryt,* is a branching structure at the receiving portion of a neuron.

Frontal lobe is the region at the front and top of each cerebral hemisphere. These two lobes are important for reason, emotion, and judgment as well as voluntary movement.

Glia, *GLY uh,* are cells that form a supporting network for the neurons in the brain.

Hypothalamus, *HY puh THAL uh muhs,* is a region in the upper part of the brain stem that controls body temperature, hunger, thirst, and the pituitary gland.

Medulla oblongata, *mih DUHL uh ahb lahng GAY tuh,* is the lowest part of the brain stem, at the top end of the spinal cord, that regulates heartbeat, breathing, and other automatic functions.

Midbrain is a middle area of the brain stem that contains many important nerve pathways.

Motor cortex is the part of both frontal lobes of the brain that controls voluntary muscle movements.

Myelin, *MY uh lihn,* is a fatty substance that surrounds and protects certain nerve fibers.

Neuron is a nerve cell. Neurons are the most important information-processing cells in the brain.

Neurotransmitters are chemicals that transmit nerve impulses between neurons.

Occipital lobe, *ahk SIHP uh tuhl,* is the region at the back of each cerebral hemisphere that contains the centers of vision.

Parietal lobe, *puh RY uh tuhl,* is the middle lobe of each cerebral hemisphere between the frontal and occipital lobes. The parietal lobes contain important sensory centers.

Pons, *pahnz,* is part of the brain stem that joins the hemispheres of the cerebellum and connects the cerebrum with the cerebellum.

Reticular formation, *rih TIHK yuh luhr,* is a network of nerve cells deep within the brain stem that plays a major role in maintaining sleep or wakefulness.

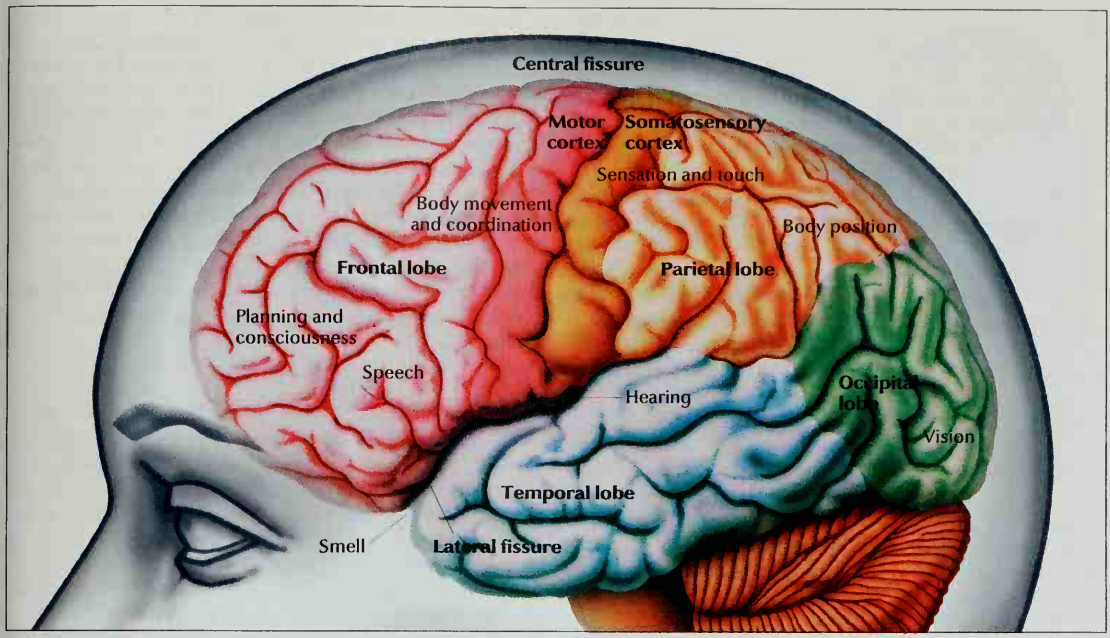
Sensory cortex is any part of the brain that receives messages from the sense organs or messages of touch and temperature from throughout the body.

Somatosensory cortex, *SOH muh tuh SEHN suhr ee,* is an area of the sensory cortex in the parietal lobes that receives messages of touch, temperature, and certain other bodily sensations.

Synapse, *sih NAPS,* is the structure where an impulse passes from one neuron to another.

Temporal lobe, *TEHM puhr uhl,* is the region at the lower side of each cerebral hemisphere. The temporal lobes contain centers of hearing and memory.

Thalamus, *THAL uh muhs,* is a structure at the top of the brain stem that serves as a relay center for sensory information.



WORLD BOOK diagram by Colin Bidgood and Barbara Cousins

The cerebrum looks wrinkled because it is covered by a deeply folded layer of nerve cells called the *cortex.* The cerebrum is divided into left and right hemispheres. Each hemisphere is further divided into four lobes by *fissures* (grooves) in the cortex. This diagram shows the left hemisphere. Labels indicate the four lobes, the fissures that separate them, and some major functions of regions of the cortex.

movement. It lies below the back part of the cerebrum. The cerebellum consists of a large mass of closely packed *folia* (leaflike bundles of nerve cells). The cerebellum has a right and a left hemisphere, with a finger-shaped structure called the *vermis* in the middle. Nerve pathways connect the right half of the cerebellum with the left cerebral hemisphere and the right side of the body. Pathways from the left half connect with the right cerebral hemisphere and the left side of the body.

The brain stem is a stalklike structure that connects the cerebrum with the spinal cord. The bottom part of the brain stem is called the *medulla oblongata* or *medulla.* The medulla has nerve centers that control breathing, heartbeat, and many other vital body processes.

Just above the medulla is the *pons,* which connects the hemispheres of the cerebellum. The pons also contains nerve fibers that link the cerebellum and the cerebrum. Above the pons lies the *midbrain.* Nerve centers in the midbrain help control movements of the eyes and the size of the pupils.

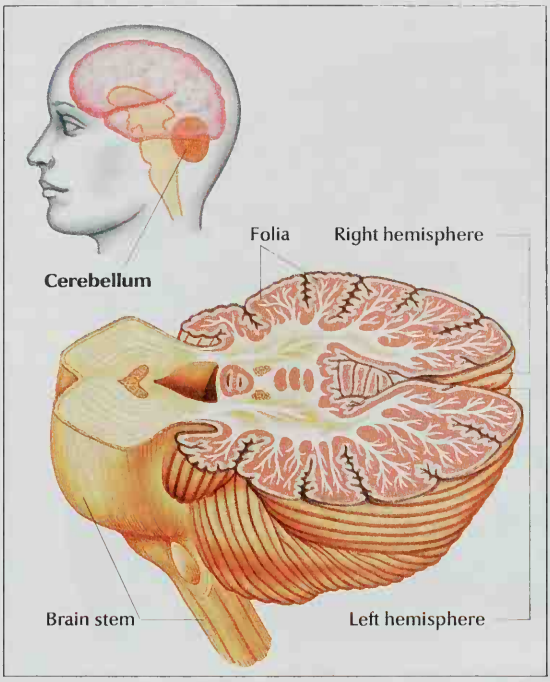
At the upper end of the brain stem are the *hypothalamus* and the *thalamus.* There are actually two thalami, one on the left side of the brain stem and one on the right side. Each thalamus receives nerve impulses from various parts of the body and routes them to the appropriate areas of the cerebral cortex. The thalami also relay impulses from one part of the brain to another. The hypothalamus regulates body temperature, hunger, and other internal conditions. It also controls the activity of the nearby *pituitary gland,* the master gland of the body (see **Hypothalamus; Pituitary gland**).

A network of nerve fibers called the *reticular formation* lies deep within the brain stem. The reticular formation helps regulate and maintain the brain's level of awareness. Sensory messages that pass through the brain stem stimulate the reticular formation, which in turn stimulates alertness and activity throughout the cerebral cortex.

Brain cells. The human brain has from 10 billion to 100 billion neurons. After a person reaches about 20 years of age, some neurons die or disappear each day. Over a lifetime, this loss equals less than 10 percent of all neurons. Scientists have found that adults can grow new neurons in the *hippocampus,* a portion of the brain associated with learning and memory.

The brain's billions of neurons connect with one another in complex networks. All physical and mental functioning depends on the establishment and maintenance of neuron networks. A person's habits and skills—such as nail-biting or playing a musical instrument—become embedded within the brain in frequently activated neuron networks. When a person stops performing an activity, the neural networks for the activity fall into disuse and eventually may disappear.

As in all other cells, a thin membrane forms the outermost layer of each neuron. However, a neuron's membrane is highly specialized to carry nerve impulses. Each neuron consists of a cell body and a number of tubelike fibers. The longest fiber, called the *axon,* carries nerve impulses from the cell body to other neurons. Short, branching fibers called *dendrites* pick up impulses from the axons of other neurons and transmit them to the cell body. The structure where any branch of one neuron transmits a nerve impulse to a branch of another neuron is called a *synapse.* Each neuron may form synapses with thousands of other nerve cells.



WORLD BOOK diagram by Colin Bidgood and Barbara Cousins

The cerebellum is the part of the brain most responsible for balance and coordination. This cross section of the cerebellum shows the folia, which are leaflike bundles of nerve cells.

Some axons have a coating of fatty material called *myelin.* The myelin insulates the fiber and speeds the transmission of impulses along its surface. Myelin is white, and tightly packed axons covered with it form *white matter.* The neuron cell bodies and the axons without myelin sheaths make up the *gray matter* of the brain. The cerebral cortex is made up of gray matter, and most of the rest of the cerebrum consists of white matter.

The neurons are surrounded by *glia,* cells whose name comes from a Greek word for *glue.* Glial cells traditionally have been thought of as a supportive framework for the neurons. The glia also perform many other important tasks. For example, certain glia keep the brain free of injured and diseased neurons by engulfing and digesting them. Other glia produce the myelin sheaths that insulate some axons. Research using cells grown in laboratories also indicates that glia, like neurons, may transmit some nerve impulses.

How the brain is protected

The hard, thick bones of the skull shield the brain from blows that could otherwise seriously injure it. In addition, three protective membranes called *meninges* cover the brain. The outermost membrane is the tough *dura mater,* which lines the inner surface of the skull. A thinner membrane, the *arachnoid,* lies just beneath the dura mater. The delicate *pia mater* directly covers the brain. It follows the folds of the brain's surface and contains blood vessels that carry blood to and from the cerebral cortex. A clear liquid called *cerebrospinal fluid* separates the pia mater and the arachnoid. This fluid forms a thin cushioning layer between the soft tissues of the brain and the hard bones of the skull.

The *blood-brain barrier* safeguards brain tissues from the damage that could result from contact with certain large molecules carried in the bloodstream. Substances in the blood reach body tissues by passing through the thin walls of tiny blood vessels called *capillaries.* Much of this flow occurs through the spaces between the cells that make up the capillary walls. In brain capillaries, the cells are more tightly packed than in other capillaries, and the passage of substances from blood to brain cells is carefully restricted. The brain needs some kinds of large molecules for nutrition, however. The capillary walls have certain enzymes and other properties that enable these particular molecules to pass through to the brain.

The work of the brain

The structure of our brain determines how we experience the world. Our experiences, in turn, influence how our neurons develop and connect with one another. Individual brains can differ significantly, depending on a person's background and experience. The fingers activate the same general area of the sensory cortex in everyone's brain. But this area is larger in people who use their fingers particularly often—for example, people who play stringed instruments, or people who read *Braille* (an alphabet of small raised dots developed for the blind).

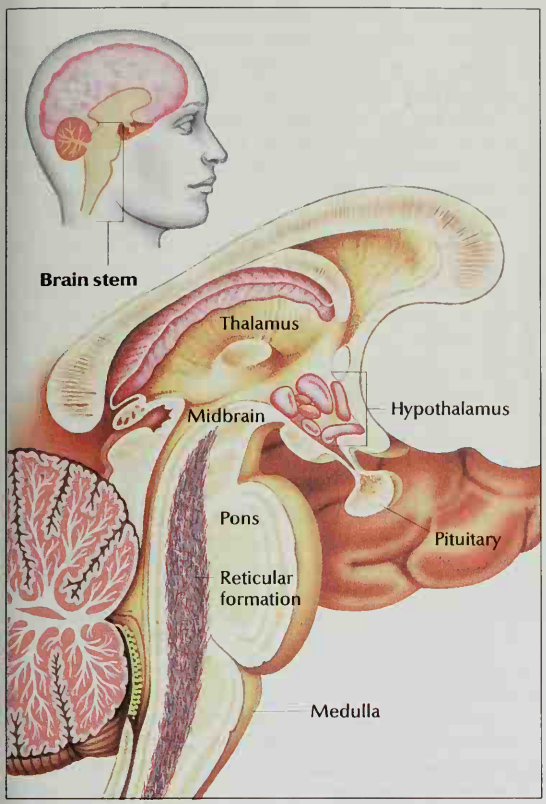
Scientists have also found evidence that the brains of men and women differ. The corpus callosum—the thick band of nerve fibers connecting the cerebral hemispheres—is larger in women. Studies of men and women reading or thinking about words also show differences. These studies have found that men generally use only their left cerebral hemisphere for processing language, but women use both hemispheres.

Researchers are not sure if these physical differences in men's and women's brains mean that men and women think differently. Some evidence suggests that the sexes may have different mental strengths. Psychological testing consistently shows that men, on the average, perform better than women on spatial tasks, such as visualizing objects in three dimensions. Women, on the other hand, do better than men on tests involving writing, reading, and vocabulary. But this average difference in ability is small. Many individual men are better at language than the average for women, and many women have better spatial skills than the average for men.

Scientists have developed many methods to study how the brain works. Experiments with animals have revealed a great deal about the workings of various areas of the brain. Scientists have also learned much about the normal activity of the brain by observing injured brains. Damage to a specific part of the brain causes predictable problems in speech, movement, or mental ability.

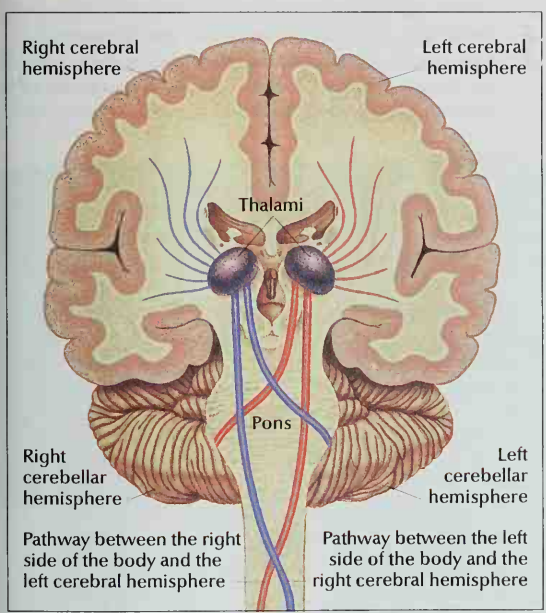
Surgeons have mapped the functions of many areas of the cerebral cortex by electrically stimulating the brain during brain surgery. Surgical operations on the brain do not require that the patients be unconscious because the brain feels no pain directly. Thus, the patients can tell the surgeons what they experience when particular brain areas are stimulated.

Brain surgery has revealed that certain functions of the cerebrum occur chiefly in one hemisphere or the



WORLD BOOK diagram by Colin Bidgood and Barbara Cousins

The brain stem is a stalklike structure that links the cerebrum with the spinal cord. The larger diagram shows a cutaway of the brain stem and the nearby pituitary gland.



WORLD BOOK diagram by Colin Bidgood

Nerve pathways cross over as they pass through the brain stem. As a result, each cerebral hemisphere is linked with the opposite side of the cerebellum and controls the opposite side of the body.

other. Surgeons treat some cases of epilepsy by cutting the corpus callosum. This operation produces a condition called the *split brain,* in which no communication occurs between the cerebral hemispheres. Studies of split-brain patients suggest that the left hemisphere largely controls our ability to use language, mathematics, and logic. The right hemisphere is the main center for musical ability, the recognition of faces and complicated visual patterns, and the expression of emotion.

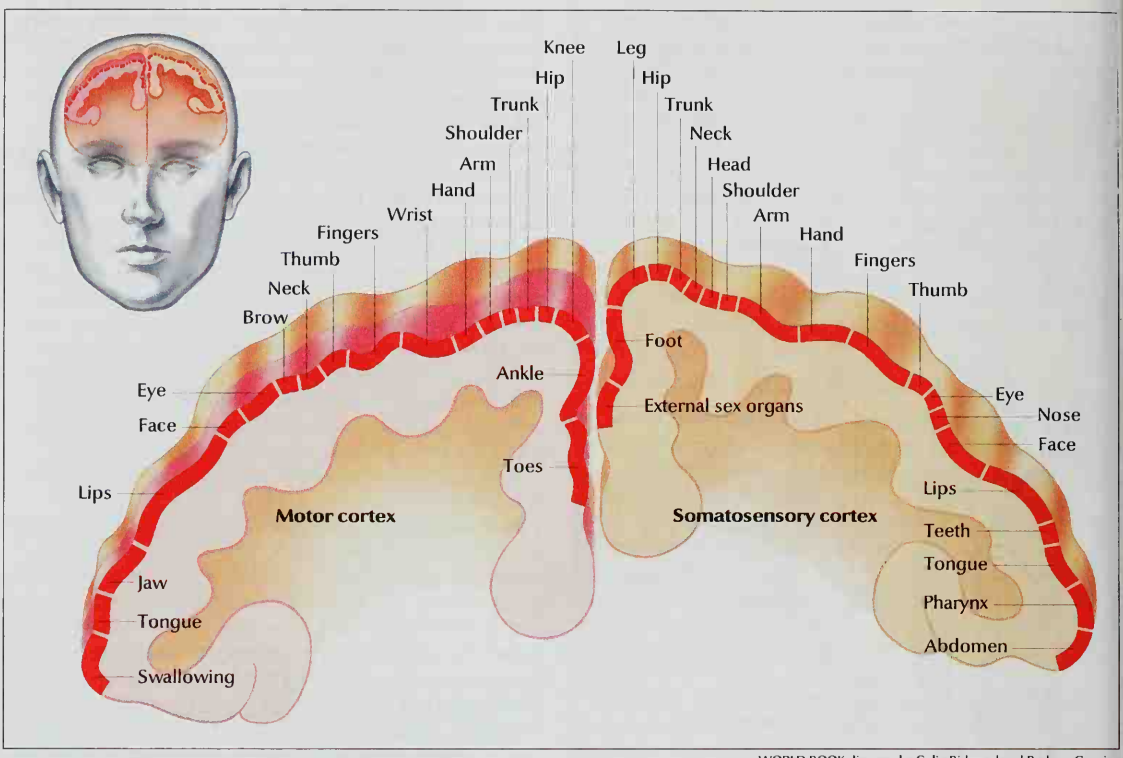
Positron emission tomography (PET) and *functional magnetic resonance imaging* (fMRI) are safe new technologies that enable scientists to study healthy, living brains at work. These technologies do not require any physical contact with the brain. They produce images similar to X rays that show which parts of the brain are active while a person performs a particular mental or physical task. PET shows the parts of the brain that are using the most glucose (a form of sugar), and fMRI shows the parts where high oxygen levels indicate increased activity.

In receiving sensory messages. Sensory messages are received and interpreted primarily in the cerebral cortex. Various parts of the body send nerve impulses to the thalamus, which routes them to the appropriate areas of the cerebral cortex. An area of the sensory cortex called the *somatosensory cortex* receives messages that it interprets as bodily sensations, such as touch and temperature. It lies in the parietal lobe of each hemisphere along the central fissure. Each part of the somatosensory cortex receives and interprets impulses from a specific part of the body.

Other specialized areas of the cerebrum receive the sensory impulses of seeing, hearing, taste, and smell. Impulses from the eyes travel to the visual cortex in the occipital lobes. Portions of the temporal lobes receive messages from the ears. The area for taste lies buried in the lateral fissure, and the center of smell is on the underside of the frontal lobes.

In controlling movement. Some reflex actions do not involve the brain. If a person touches a hot stove, for example, pain impulses flash to the spinal cord, which immediately sends back a message to withdraw the hand. However, the brain plays the major role in controlling our conscious movements as well as those we are unaware of. The *basal ganglia* are groups of neurons that lie at the base of the cerebrum. The basal ganglia help control well-learned movement sequences involved in such activities as walking or eating. Areas in the brain stem control the movements of the body's *involuntary muscles,* which line the walls of the stomach, intestines, and blood vessels.

The cerebral cortex and the cerebellum together largely regulate voluntary movements. The motor cortex in each cerebral hemisphere sends nerve impulses to the particular muscles used in an activity, such as writing or throwing a ball. The motor cortex lies in the frontal lobe in front of the central fissure. Each area of the motor cortex controls the movements of a specific part of the body. The largest areas control those parts of the body that make the most complicated and precise movements. Thus, a large area controls the lips and tongue, which make complex movements in speaking. Much smaller areas control the relatively simple movements made by such parts as the back and shoulders.



WORLD BOOK diagram by Colin Bidgood and Barbara Cousins

Regions within the motor and somatosensory areas of the cortex are linked to specific parts of the body. The largest areas within the motor cortex control the parts of the body that make the most complex voluntary movements. The largest areas within the somatosensory cortex receive sensory input from the most sensitive body parts.

The major motor pathways to the body cross over in the brain stem. The motor cortex of the left hemisphere thus controls movements on the right side of the body. Similarly, the right motor cortex directs movements on the left side of the body. More than 90 percent of all people are right-handed because the left motor cortex, which directs the right hand, is dominant over the right motor cortex, which directs the left hand.

The cerebellum coordinates the muscle movements ordered by the motor cortex. Nerve impulses alert the cerebellum when the motor cortex orders a part of the body to perform a certain action. Almost instantly, impulses from that part of the body inform the cerebellum of how the action is being carried out. The cerebellum compares the movement with the intended movement and then signals the motor cortex to make any necessary corrections. In this way, the cerebellum ensures that the body moves smoothly and efficiently.

In the use of language. In the late 1800's, scientists observed that damage to particular parts of the brain caused the same language disabilities in most patients. Damage to the left frontal lobe in *Broca's area*, named for French surgeon Pierre Paul Broca, destroyed the ability to speak. Damage to the left temporal lobe in *Wernicke's area*, named for German neurologist Carl Wernicke, caused difficulty understanding language. These observations led many scientists to think that the brain processed words in an orderly relay through a series of language-related areas. But new imaging technologies such as PET and fMRI enable scientists to observe the brain directly while people speak, listen, read, and think. PET and fMRI studies show that language processing is extremely complex. Language areas are spread widely through the brain, and different types of language tasks activate these areas in many sequences and patterns.

In regulating body processes. The main control centers for body processes are in the brain stem. Nerve centers in the medulla regulate such body functions as breathing, heartbeat, and blood flow. Other areas within the brain stem control swallowing and the movements of the stomach and intestines.

The hypothalamus also has nerve centers that control certain body processes. Most of these centers maintain constant conditions within the body. For example, some centers regulate the amount of water in the body. Certain neurons detect changes in the level of water in the body's blood and tissues and relay this information to the hypothalamus. If the water level is too low, the hypothalamus produces the sensation of thirst, which causes the person to drink water. At the same time, the hypothalamus sends messages that cause the kidneys to reduce the amount of water they remove from the body. If the water level becomes too high, the messages from the hypothalamus eliminate thirst and increase the amount of water removed by the kidneys. Other centers in the hypothalamus operate on the same principle in regulating hunger and body temperature.

A slender stalk of tissue connects the hypothalamus with the master gland of the body, the pituitary. The hypothalamus indirectly regulates many body processes by controlling the pituitary's production and release of chemical messengers called *hormones*. Among other functions, these hormones regulate the body's rate of growth and its sexual and reproductive processes.

In producing emotions. The emotions we experience involve many areas of the brain as well as other body organs. A group of brain structures called the *limbic system* plays a central role in the production of emotions. This system includes portions of the temporal lobes, parts of the hypothalamus and thalamus, and other structures.

An emotion may be provoked by a thought in the cerebral cortex or by messages from the sense organs. In either case, nerve impulses are produced that reach the limbic system. These impulses stimulate different areas of the system, depending on the kind of sensory message or thought. For example, the impulses might activate parts of the system that produce pleasant feelings involved in such emotions as joy and love. Or the impulses might stimulate areas that produce unpleasant feelings associated with anger or fear.

In thinking and remembering. Scientists have only an elementary understanding of the extraordinarily complicated processes of thinking and remembering. Thinking involves processing information over circuits in the association cortex and other parts of the brain. These circuits enable the brain to combine information stored in the memory with information gathered by the senses. Scientists are just beginning to understand the brain's simplest circuits. Forming abstract ideas and studying difficult subjects must require circuits of astonishing complexity. Some aspects of human thinking—such as religious or philosophical beliefs—are still beyond scientists' understanding and may always be.

The frontal lobes of the cerebrum play a key role in many thinking processes that distinguish human beings from other animals. The frontal lobes are particularly important for abstract thinking, for imagining the likely consequences of actions, and for understanding another person's feelings or motives. Injury or abnormal development of the frontal lobes can result in the loss of these abilities.

Scientists also have much to learn about the physical basis of memory. Certain structures of the limbic system appear to play major roles in storing and retrieving memories. These structures include the *amygdaloid complex* and the *hippocampus*, both in the temporal lobe. Individuals who suffer damage to these structures may lose the ability to form new memories, though they may retain information about events occurring before the damage. These individuals can learn new physical skills, but when performing them do not remember having done the activities before.

Evidence suggests that memories may be formed through the establishment of new brain circuits or the alteration of existing circuits. Either process would involve changes at the synapses—that is, at the structures where impulses pass from one neuron to another. These changes may be controlled by *glycoproteins* or other large molecules at the synapses. Extensive research will be required to verify this general explanation of memory formation and to discover the specific details of the processes involved.

The chemistry of the brain

As in all other cells, many complex chemical processes occur within the neurons of the brain. However, some chemical processes occur only within and among neurons. Scientists are especially interested in gaining a fuller understanding of these processes and how they relate to the transmission of nerve impulses.

A nerve impulse is an electrical and chemical process controlled by the nerve cell membrane. The process involves *ions* (electrically charged atoms) of chemical elements, such as sodium and potassium. The membrane, which has pores, maintains varying concentrations of these ions inside the neuron and in its surrounding fluids. As the membrane selectively allows ions to enter and leave the cell, an electric charge—the nerve im-

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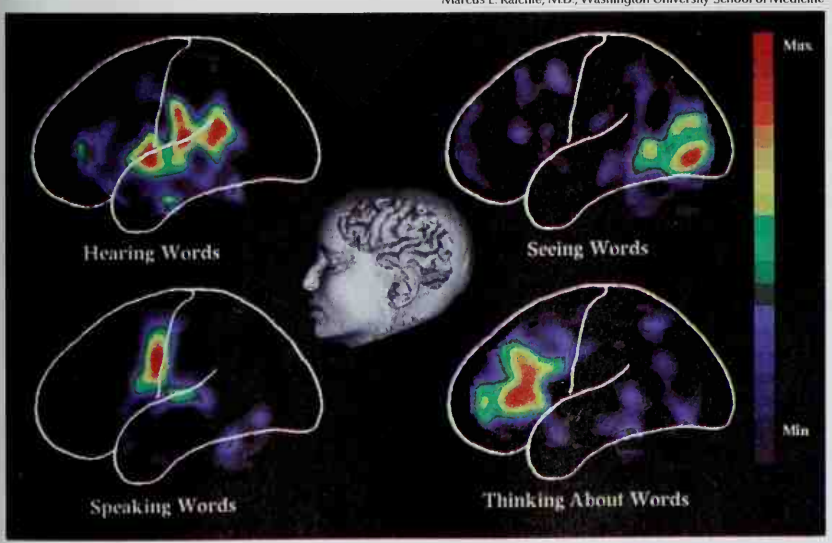


Positron emission tomography (PET) images show brain activity. These PET scans show areas of the left cerebral hemisphere that are active while people perform language tasks. The white outline highlights the cerebrum and its central and lateral fissures. Neurons are most active where an image is red. Neuron activity decreases as the colors progress through the spectrum from red to violet.

pulse—travels along the neuron. For more details about this process, see Nervous system (How neurons carry impulses). The rest of this section discusses the chemicals that transmit impulses from neuron to neuron.

The brain's chemical messengers. Certain chemicals called *neurotransmitters* make it possible for a nerve impulse to travel from the axon of one neuron to the dendrite of another. An impulse cannot be transmitted electrically across the *synaptic cleft,* the tiny gap between the axon and the dendrite. Instead, when an impulse reaches the end of the axon, it triggers the release of neurotransmitter molecules from the cell. These molecules cross the synaptic cleft and attach themselves to sites called *receptors* on the dendrite of the other neuron. This action alters the electrical activity of the receiving neuron in one of two ways. Some transmitters stimulate the neuron to produce a nerve impulse. Others tend to prevent the neuron from producing an impulse.

Neurons may manufacture more than one neurotransmitter, and their membrane surfaces may contain receptors for more than a single transmitter. A neuron may "learn" from past experience and change the proportions of its various neurotransmitters and receptors. Thus, the brain has great flexibility and can alter its response to situations encountered over spans of time ranging from seconds to decades.

The brain produces many kinds of chemicals that are used as neurotransmitters. The most common ones include *acetylcholine, dopamine, norepinephrine,* and *serotonin.* The chemicals are not distributed evenly throughout the brain. Each is found only or primarily in specific areas. For example, the cell bodies of neurons that contain dopamine are in the midbrain of the brain stem. The axons of these cells reach into other areas, including the frontal lobes of the cerebrum and an area near the center of the brain called the *corpus striatum.* These dopamine pathways function in the regulation of emotions and in the control of complex movements.

During the 1970's, researchers discovered that morphine and related drugs relieve pain by attaching to receptors in certain regions of the brain. This discovery suggested that the brain produces its own painkillers that attach to these same receptors. Further research led to the discovery of *endorphins* and *enkephalins,* two neurotransmitters that bind to these receptors.

In the 1980's, researchers found that receptors exist in families. Each member or subtype of a family is responsible for a specific function. For example, scientists have discovered more than a dozen receptor subtypes for serotonin. This knowledge has led to development of drugs that affect specific serotonin receptors, such as migraine drugs and certain antidepressants. Scientists believe that the discovery of additional receptor subtypes will result in the development of drugs that work with increased precision in the treatment of thought, mood, and behavior disorders.

Brain chemistry and mental illness. All the brain's functions depend on the normal action of neurotransmitters. An excess or deficiency of a specific transmitter or group of transmitters may lead to a serious disorder in thought, mood, or behavior. For example, studies have suggested that chemical imbalances in the brain play a significant role in several types of mental illnesses. There is some evidence that the brain produces too much dopamine in a severe mental illness called *schizophrenia.* This excess of dopamine may create emotional disturbances and cause a person to see things and hear sounds that do not exist.

Disturbances in brain chemistry may also be involved in *bipolar disorder,* also known as *manic-depressive disorder.* A person with this mental illness has alternate periods of *mania* (extreme joy and overactivity) and *depression* (sadness). Some research suggests that an excess of dopamine, norepinephrine, and serotonin causes mania and that a deficiency of the same chemicals causes depression.

How drugs affect brain chemistry. Psychiatrists treat some mental illnesses with drugs that restore the brain's normal chemical activity. For example, many tranquilizers that relieve the symptoms of schizophrenia block the brain's receptors for dopamine. However, it seems unlikely that a single neurotransmitter is responsible for schizophrenia or other complex mental illnesses, such as bipolar disorder and depression. These disorders probably result from chemical disturbances involving several neurotransmitters. For example, some drugs that have proved successful in treating depression influence norepinephrine, while others influence serotonin. Still others affect both of these neurotransmitters.

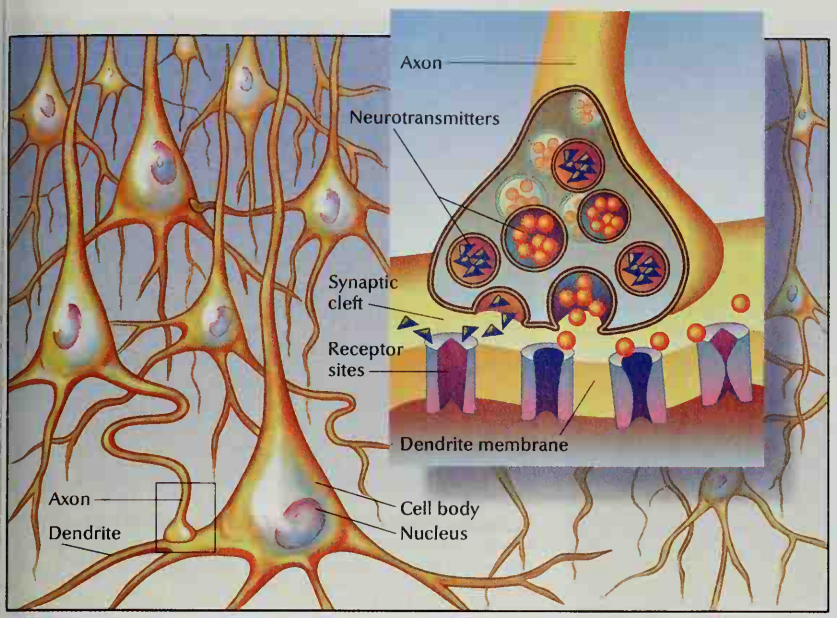
Certain drugs produce a feeling of well-being or reduce tension and worry by temporarily altering the normal chemistry of the brain. For example, *amphetamines* increase mental activity by causing brain cells to release an excessive amount of dopamine. Abuse of amphetamines can create mental disturbances like those that occur in some forms of schizophrenia.

A person's senses, emotions, thought processes, and judgment can be altered dramatically and dangerously by *hallucinogenic drugs.* These drugs include mescaline, psilocybin, and LSD (lysergic acid diethylamide). Each of these drugs structurally resembles one or more neurotransmitters. Mescaline resembles dopamine and norepinephrine, and LSD and psilocybin resemble serotonin. Scientists think a hallucinogenic drug may produce its effects by combining with the brain's receptors for the natural transmitter that it resembles. Hallucinogenic drugs may produce disturbances in brain chemistry that last long after their contact with the brain. For example, scientists believe that the drug called *MDMA,* commonly known as Ecstasy, may cause permanent damage to neurons that release serotonin. This damage may produce harmful effects on mood, thoughts, sleep, and motivation.

Disorders of the brain

Injuries, diseases, and inherited disorders can damage the brain. However, the seriousness of brain damage depends chiefly on the area of the brain involved rather than on the cause of the damage. Disorders that destroy brain cells are especially serious because the body cannot replace the lost cells. In some cases, however, undamaged areas of the brain may eventually take over control of some functions formerly carried out by the damaged areas.

Modern instruments and techniques enable physicians to diagnose brain disorders earlier and more accurately than in the past. For example, an instrument called an *electroencephalograph* (EEG) measures the patterns of electrical activity produced by the brain. Differences from



WORLD BOOK illustration by Barbara Cousins

Networks of neurons, *background,* form the brain's information-processing circuits. Information in the form of neurotransmitter chemicals travels from one neuron to another at the synapse, *inset.* Neurotransmitters leave the axon of the transmitting neuron and enter specific receptor sites in the membrane of the receiving dendrite.

normal EEG patterns may indicate damage to the brain and also help locate the area of the damage. Computer-assisted EEG's can record and organize vast amounts of electrical data. The brain's responses to specific visual, auditory, and touch stimuli can be measured. Scientists can diagnose disorders by comparing the responses with average results obtained from large numbers of people. Another important technique is *computed tomography* (CT). It involves X-raying the brain in detail from many angles. A computer then analyzes the X-ray data and constructs a cross-sectional image of the brain on a TV screen. *Magnetic resonance imaging* (MRI) uses magnetic fields and radio waves to produce images of the brain's structure.

Injuries are the leading cause of brain damage among people under 50 years of age. A blow to the head may cause temporary unconsciousness without permanent damage. Severe injuries to the head may cause more serious brain damage. Head injuries before, during, or shortly after birth may cause *cerebral palsy.* There are several types of cerebral palsy, all of which involve lack of control of muscle movements.

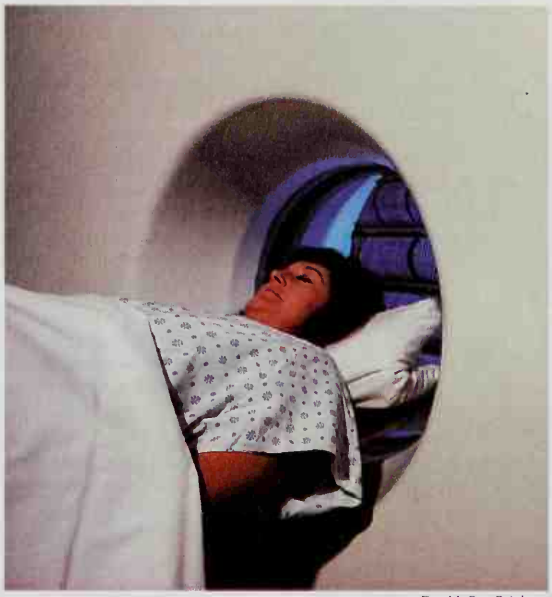
Stroke is the most common serious disorder of the brain. A stroke occurs when the blood supply to part of the brain is cut off. Nerve cells in the affected areas die, and the victim may lose the ability to carry out functions controlled by those areas. Many stroke victims suffer paralysis on one side of the body. Other symptoms include difficulty in speaking or in understanding language. Most strokes result from damage to the blood vessels caused by *hypertension* (high blood pressure) or *arteriosclerosis* (hardening of the arteries). Some victims of massive strokes die, but many other stroke victims survive and recover at least partially.

Tumors are abnormal growths that can cause severe brain damage. The effects of a tumor depend on its size and location. A tumor may destroy brain cells in the area surrounding it. As the tumor grows, it also creates pressure, which may damage other areas of the brain or at least interfere with their normal function. Symptoms of a tumor include headache, seizures, unusual sleepiness, a change in personality, or disturbances in sense perception or speech.

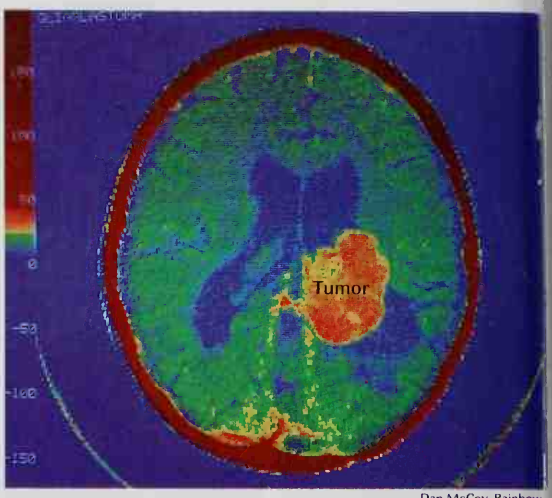
Surgery cures some tumors. For cancerous tumors, physicians may combine surgery with drugs or radiation. One type of radiation, called *stereotactic radiosurgery,* is sometimes used as an alternative to traditional surgery. In stereotactic radiosurgery, doctors use computers and a CT scan or MRI to produce a three-dimensional image of the brain. Beams of radiation are then focused precisely on the target, which may be a tumor or a blood-vessel malformation. The individual beams are either too brief or too weak to harm areas of the brain in the path of the radiation. But their combined effect will destroy the target. These procedures are quick and painless and allow patients to resume moderate activity the same day.

Infectious diseases. A number of diseases caused by bacteria or viruses can damage the brain. The most common of these infectious diseases are *encephalitis* and *meningitis,* either of which may be caused by bacteria or viruses. Encephalitis is an inflammation of the brain. *Meningitis* is an inflammation of the meninges, the membranes that cover the brain and spinal cord. *Chorea* is a disease of the brain that mainly affects children from 7 to 15 years old. Most cases of chorea occur with rheumatic fever and may be caused by the same bacteria which cause that disease. A virus disease called *poliomyelitis* attacks the brain and spinal cord. Vaccines to prevent polio were developed in the 1950's.

Genetic disorders. Our *genes* (the hereditary materials in cells) carry instructions for the development of our entire bodies, including the brain. These instructions are extremely complex, and therefore errors occasionally occur. These errors can result in serious defects in the structure and functioning of the brain. Some infants are mentally retarded at birth because genetic errors caused the brain to develop improperly during the



Dan McCoy, Rainbow



Dan McCoy, Rainbow

Computerized tomography (CT) aids in detecting brain tumors and other abnormalities. The CT scanner, *left*, X-rays the brain from many angles. From the X-ray data, the scanner's computer constructs images of the brain, *above*.

mother's pregnancy. In *Down syndrome*, for example, an extra *chromosome* is present. Chromosomes are structures in the cell nucleus that contain the genes. The extra chromosome causes mental retardation as well as physical defects. Another disorder that causes mental retardation is *fragile-X syndrome*. This disorder results from an abnormality on the X chromosome, one of the chromosomes that determine a person's sex.

Some children suffer severe brain damage after birth because of an inherited deficiency of an enzyme that the body needs to use foods properly. For example, a child who has *phenylketonuria* (PKU) lacks an enzyme needed to convert a certain *amino acid* (protein part) into a form the body can use. This amino acid, *phenylalanine*, accumulates in the blood and damages developing brain tissues. A diet low in phenylalanine can prevent brain damage in people who have PKU.

Some genetic errors damage the brain only later in life. *Huntington's disease*, for example, usually strikes during middle age. The disease causes various areas of the cerebrum and basal ganglia to wither away. Involuntary jerky movements are the main early symptoms of Huntington's disease. However, the disease eventually leads to incurable mental disintegration.

Scientists believe that genetic factors play an important role in most cases of *Alzheimer's disease*. This disease most commonly strikes after age 60. It is characterized by an increasingly severe loss of memory and other mental abilities. Most people with Alzheimer's disease eventually cannot care for themselves and become bedridden.

Heredity also plays a role in some types of mental illness. Many children of schizophrenics apparently inherit a tendency to develop schizophrenia. Studies have also revealed an inherited tendency to develop bipolar disorder. These tendencies may involve inherited defects in brain chemistry. Researchers continue to study these tendencies and how they interact with environmental conditions to produce mental illness.

Other brain disorders include (1) epilepsy, (2) multiple sclerosis (MS), and (3) Parkinson disease. Scientists do not know the cause of these disorders.

Epilepsy. Victims of epilepsy suffer seizures that occur when many nerve cells in one area of the brain release abnormal bursts of impulses. A seizure may cause temporary uncontrolled muscle movements or unconsciousness. Defects in genes cause some cases of epilepsy, but the cause of most cases is not known. Physicians treat epilepsy with drugs that reduce the number of seizures or prevent them entirely.

Multiple sclerosis develops when axons in parts of the brain and spinal cord lose their myelin sheaths. As a result, the axons cannot carry nerve impulses properly. Symptoms vary depending on what brain areas are affected, but they may include double vision, loss of balance, and weakness in an arm or leg. No cure is yet known. Drugs can relieve some of the symptoms. Some of these drugs help slow the loss of myelin.

Parkinson disease is characterized by slowness of movement, muscle rigidity, and trembling. These conditions result in part from the destruction of the nerve pathways that use dopamine as a transmitter. Treatment with the drug L-dopa replaces the missing dopamine and so can relieve the symptoms of Parkinson disease, though it cannot cure the illness. Some researchers have treated Parkinson disease by transplanting dopamine-producing brain tissue from fetuses into part of the basal ganglia, which help control body movement. This procedure is risky, and its usefulness has not yet been proved. In addition, it has aroused controversy on moral grounds because the fetal cells are obtained during abortions.

The brain in animals

Most *invertebrates* (animals without a backbone) do not have a well-developed brain. Instead, they have clusters of nerve cells, called *ganglia*, that coordinate the activities of the body. All *vertebrates* (animals with a back-

bone) have a complex brain. Scientific evidence suggests the complex brain in higher animals *evolved* (developed gradually) through the ages (see Evolution).

In invertebrates. The more advanced invertebrates, such as worms and insects, have some type of relatively simple brain. An earthworm, for example, has in its head region a large pair of ganglia that control the worm's behavior on the basis of information received from the sense organs. An insect has a more complex brain that consists of three pairs of ganglia. The ganglia receive information from the sense organs and control such complex activities as feeding and flying.

Octopuses have the most highly developed brain among invertebrates. Their brain is divided into several parts, the largest of which is the *optic lobe.* The optic lobe processes information from an octopus's eyes, which resemble the eyes of vertebrates in structure and function.

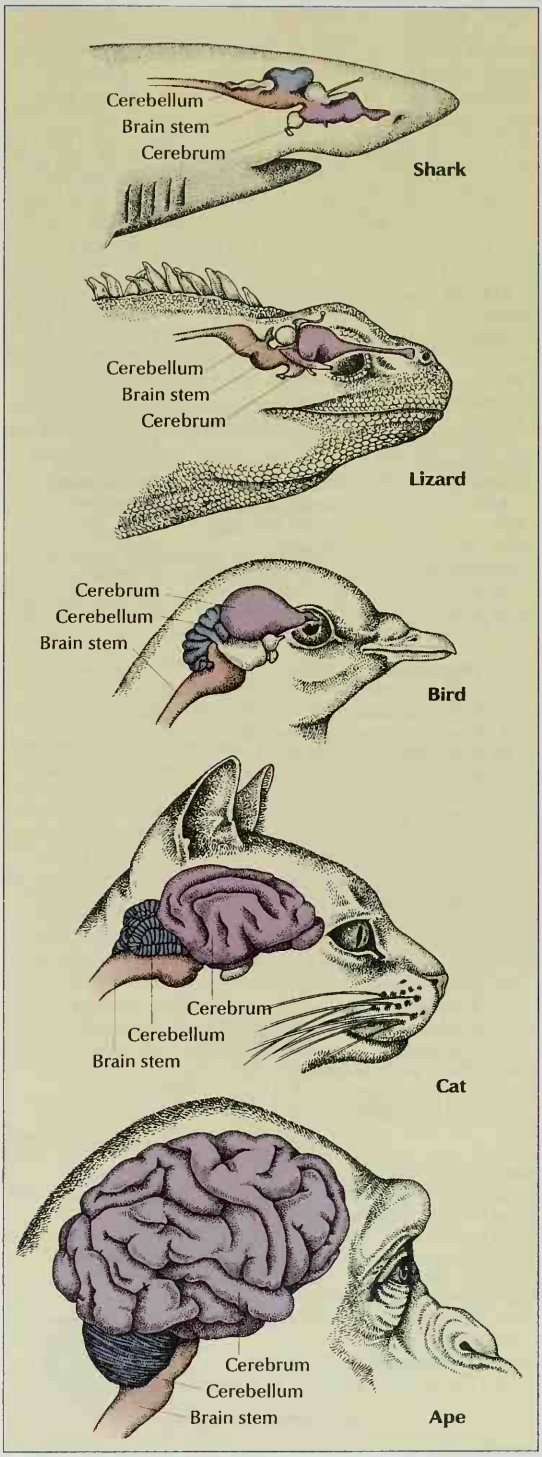
In vertebrates, the brain can be divided into three main regions: (1) the forebrain, (2) the midbrain, and (3) the hindbrain. The midbrain is the most highly developed region in primitive vertebrates, such as fish and amphibians. In contrast, the forebrain, or cerebrum, makes up only a small part of the brain in these animals. As increasingly complex vertebrates evolved, two major changes occurred in the brain. The size and importance of the cerebrum increased enormously, and the relative size and importance of the midbrain decreased. The hindbrain consists of the medulla and the cerebellum. Its structure and function is basically the same in all vertebrates, though the cerebellum is larger and more complex in advanced animals.

Among fish and amphibians, the midbrain consists chiefly of two optic lobes. These lobes serve not only as the center of vision but also as the major area for coordinating sensory and motor impulses. A fish's cerebrum is composed of two small, smooth swellings that serve mainly as the center of smell. In amphibians, the cerebrum is slightly larger and is covered by a cortex.

In reptiles, some functions of the midbrain have been taken over by the cerebrum. A reptile's cerebrum is larger and more complex than that of a fish or amphibian. Within the cerebrum are basal ganglia. These small bundles of neurons form a major area where information is analyzed, processed, and stored. Some advanced reptiles have a small area of cerebral cortex that differs from the cortex in lower vertebrates. This area, called the *neocortex,* functions as an important area for information processing and storage.

Birds have a cerebrum larger than that of fish, amphibians, and reptiles. But unlike some advanced reptiles, birds lack a neocortex. Instead, the dominant part of their brain consists of large, highly developed basal ganglia, which fill most of the interior of the cerebrum. The basal ganglia serve as the main center for processing and storing information and give birds an impressive ability to learn new behavior. The ganglia apparently also store the instructions for the many instinctive behavior patterns of birds. Birds also have a well-developed cerebellum, which coordinates all the sensory and motor impulses involved in flying.

The brain reaches its highest level of development in mammals. The neocortex forms nearly all the cerebral cortex of the mammalian brain, and the midbrain serves



WORLD BOOK illustrations by Patricia J. Wynne

Brains of some vertebrates show the progression of brain development as animals evolved over millions of years. Sharks and other fish have a relatively simple brain with a small, smooth cerebrum. The cerebrum is larger but still quite smooth in reptiles and birds. The most advanced mammals, such as cats and apes, have a large, wrinkled cerebrum with billions of neurons.

mainly as a relay center. The most primitive mammals, such as moles and shrews, have a relatively small cerebrum with a smooth cerebral cortex. More advanced mammals, such as horses and cats, have a larger cerebrum covered by a cortex with many ridges and grooves. These indentations increase the surface area of the brain. Whales and dolphins have a large, highly developed brain. The brain in chimpanzees and other apes is even more highly developed. It resembles the human brain more closely than does the brain in any other species of animals. Richard Restak

Related articles in *World Book* include:

Alzheimer's disease	Electroencephalograph	Penfield, Wilder G.
Aneurysm	Encephalitis	Perception
Aphasia	Endorphin	Phrenology
Biofeedback	Epilepsy	Poliomyelitis
Cerebral hemorrhage	Huntington's disease	Positron emision tomography
Cerebral palsy	Mad cow disease	Psychosis
Cerebrospinal fluid	Meningitis	Reflex action
Chorea	Mental illness	Schizophrenia
Concussion	Mental retardation	Senility
Creutzfeldt-Jako disease	Migraine	Serotonin
Dopamine	Multiple sclerosis	Skull
	Nervous system	Stimulant
	Parkinson disease	Stroke
		Tay-Sachs disease

Outline

I. **The parts of the brain**
   A. The cerebrum
   B. The cerebellum
   C. The brain stem
   D. Brain cells
II. **How the brain is protected**
III. **The work of the brain**
   A. In receiving sensory messages
   B. In controlling movement
   C. In the use of language
   D. In regulating body processes
   E. In producing emotions
   F. In thinking and remembering
IV. **The chemistry of the brain**
   A. The brain's chemical messengers
   B. Brain chemistry and mental illness
   C. How drugs affect brain chemistry
V. **Disorders of the brain**
   A. Injuries
   B. Stroke
   C. Tumors
   D. Infectious diseases
   E. Genetic disorders
   F. Other brain disorders
VI. **The brain in animals**
   A. In invertebrates
   B. In vertebrates

Questions

How much does the human brain weigh?
What is the most common serious disorder of the brain?
What is the function of the motor cortex?
What are the three main divisions of the human brain?
Which invertebrates have the most highly developed brain?
How does the blood-brain barrier safeguard the brain tissues?
Which brain area regulates breathing?
How does the hypothalamus regulate the amount of water in the body?
Why are most people right-handed?
Which animals have a brain most similar to the human brain?

Additional resources

Level I

Barmeier, Jim. *The Brain.* Lucent Bks., 1996.
Parker, Steve. *The Brain and Nervous System.* Raintree Steck-Vaughn, 1997.
Simon, Seymour. *The Brain.* Morrow, 1997.

Level II

Calvin, William H. *How Brains Think.* Basic Bks., 1996.
Greenfield, Susan A. *The Human Brain.* Basic Bks., 1997. *The Human Mind Explained.* Holt, 1996.
Ramachandran, V. S., and Blakeslee, Sandra. *Phantoms in the Brain.* Morrow, 1998.
Restak, Richard M. *Brainscapes.* Hyperion, 1995.
Turkington, Carol. *The Brain Encyclopedia.* Facts on File, 1996.

Brain death. See Death (Defining death).

Brainwashing is a method of influencing people to change their beliefs and accept as true what they previously had considered false. The term was originally used to refer to methods practiced by the Chinese Communists. Brainwashing described "thought reform" programs they developed after taking control of China in 1949.

During the Korean War (1950-1953), the Chinese and North Koreans used similar techniques to convert American prisoners to Communism. This form of brainwashing begins by isolating the victims in a prison cell or a small room. They are told repeatedly and harshly that their political, religious, or social beliefs are wrong. They are also shown the advantages of their captor's position. Many victims are starved and allowed little or no sleep. Such torment eventually causes some people to give up their beliefs and accept those of their persecutors. Most victims regain their original beliefs soon after returning to their own environment.

Some religious sects have been accused of brainwashing their members. Many of these groups forbid new members to contact their family or friends outside the sect. Such isolation has led people to accuse the sects of putting the newcomers under mental pressure to accept the sects' beliefs. Kenneth J. Gergen

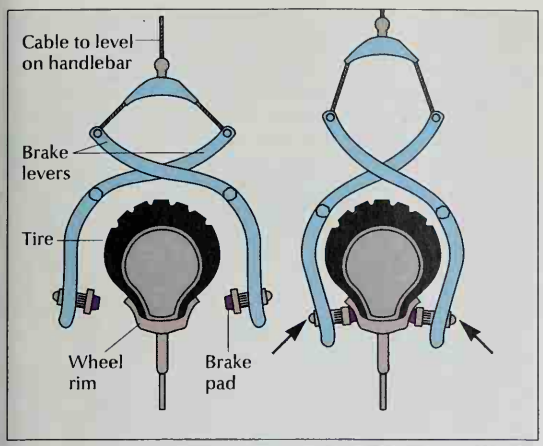
Brake is a device that slows or stops a moving object. Most brakes have a part called a *brake pad* or *brake shoe* that presses against a turning wheel—or a unit connected to the wheel—to produce friction. This friction converts the wheel's energy of motion to heat, slowing or stopping the wheel. Vehicles and industrial machines use a wide variety of brakes. This article describes brakes used chiefly in vehicles.

Vehicles are equipped with three major kinds of brakes: (1) mechanical brakes, (2) hydraulic brakes, and (3) air brakes.

Mechanical brakes have levers or cables that force one or two pads against the wheel. Most bicycles have two mechanical brakes called *caliper brakes,* one for each wheel. Each brake has two small rubber pads, one on each side of the wheel rim. The pads are mounted on a mechanical device that is connected to one end of a long cable. The other end of the cable is connected to a lever on the handlebar. When the rider squeezes this lever, force on the cable presses the pads against the wheel rim.

Automobiles are equipped with another kind of mechanical brake called an *emergency brake* or *hand brake.* This brake is also known as a *parking brake* because it helps prevent a parked car from rolling away. When the driver applies the emergency brake, a system of levers, rods, and cables applies pressure to the pads or shoes of the rear wheels.

Hydraulic brakes use a special liquid called *brake fluid* to apply brake pressure to pads or shoes. Most automobiles have a hydraulic braking system. The main parts of this system are a chamber called a *master*



WORLD BOOK illustration by Bensen Studios

Mechanical brakes are commonly used on bicycles. When the rider squeezes a lever on the handlebar, two brake levers press rubber brake pads against the wheel rim, slowing the wheel.

cylinder, which is located near the brake pedal; at least one *wheel cylinder* at each wheel; and tubes called *brake lines,* which connect the master cylinder to the wheel cylinders. The cylinders and brake lines are filled with brake fluid.

Inside the master cylinder is a piston, which can slide back and forth. In a simple hydraulic system, the brake pedal controls this piston by means of a rod or some other mechanical link. When the driver pushes on the pedal, the piston inside the master cylinder exerts pressure on the fluid and slides forward a short distance. The fluid transmits this pressure through the brake lines, forcing pistons in the wheel cylinders to move forward. As the wheel cylinders move forward, they apply brake pressure to pads or shoes.

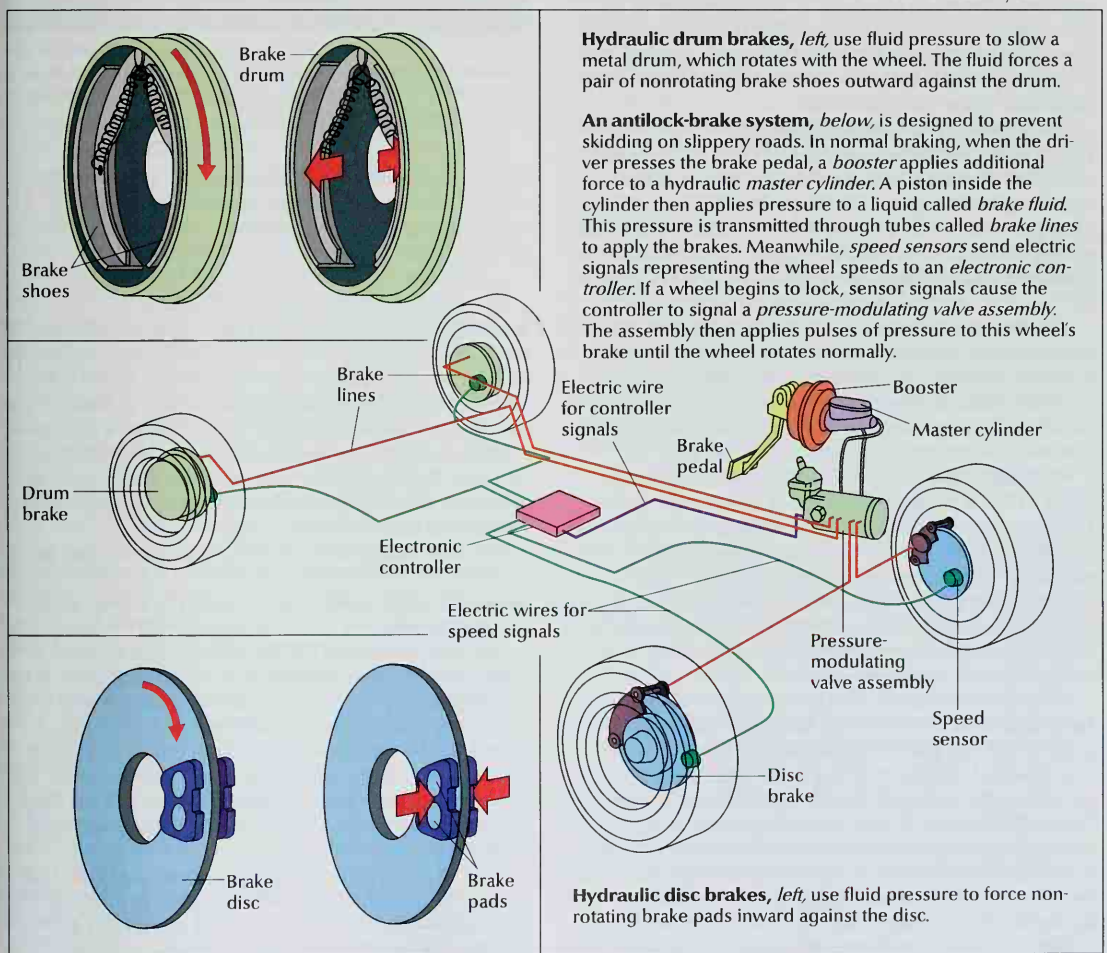
The wheel cylinders are mounted in either *disc brakes* or *drum brakes.* Most cars have disc brakes on the front wheels and drum brakes on the rear wheels.

Disc brakes have a disc, which is usually made of cast iron, attached to the vehicle's axle. The wheel is attached to the disc. A U-shaped *caliper assembly* fits around a

Automobile brakes

Most automobiles have a hydraulic braking system, which uses the pressure of a special fluid to apply the brakes. Cars usually have disc brakes on the front wheels and drum brakes on the rear wheels. Some automobiles also have an *antilock-brake system* to prevent skidding.

WORLD BOOK illustrations by Bensen Studios



Hydraulic drum brakes, *left,* use fluid pressure to slow a metal drum, which rotates with the wheel. The fluid forces a pair of nonrotating brake shoes outward against the drum.

An antilock-brake system, *below,* is designed to prevent skidding on slippery roads. In normal braking, when the driver presses the brake pedal, a *booster* applies additional force to a hydraulic *master cylinder.* A piston inside the cylinder then applies pressure to a liquid called *brake fluid.* This pressure is transmitted through tubes called *brake lines* to apply the brakes. Meanwhile, *speed sensors* send electric signals representing the wheel speeds to an *electronic controller.* If a wheel begins to lock, sensor signals cause the controller to signal a *pressure-modulating valve assembly.* The assembly then applies pulses of pressure to this wheel's brake until the wheel rotates normally.

Hydraulic disc brakes, *left,* use fluid pressure to force nonrotating brake pads inward against the disc.

part of the disc but does not rotate with the disc. This assembly includes one or two wheel cylinders, each containing a piston and two brake pads—one on each side of the disc. The pads are flat pieces of metal lined with a heat-resistant material. When the brake is applied, the pads press inward against the disc.

Drum brakes have a drum, usually cast iron, fastened to the axle. The wheel is attached to the drum. Inside the drum are two semicircular brake shoes that are lined with a heat-resistant material. The shoes do not rotate with the drum. Between the shoes is a wheel cylinder. This cylinder has two pistons, which push in opposite directions—one against each shoe. When the brake is applied, the shoes press outward against the drum.

Power-assisted brakes provide additional brake pressure in most automobiles. A device called a *booster* is mounted between the brake pedal and the master cylinder. When the driver steps on the pedal, the booster uses the difference in pressure between the vacuum in the engine and the surrounding atmosphere to apply additional pressure to the piston in the master cylinder.

Antilock-brake systems are installed in some automobiles to prevent wheels from locking and skidding on wet or icy roads. An antilock-brake system (ABS) includes a sensor at each wheel and a tiny computer called an *electronic controller*. A device known as a *pressure-modulating valve assembly* is mounted between the master cylinder and the wheel cylinders. Electric wires connect the sensors to the controller and the controller to the valve assembly.

The sensors send electric signals that represent wheel speed to the electronic controller. When a sensor indicates that a wheel is locking, the controller transmits a signal to the valve assembly. The assembly, in turn, applies pulses of brake pressure to the brake of the locked wheel. This pressure alternately applies and releases the brake. Pulsing continues until the wheel rotates normally.

Traction control, available in some cars with antilock brakes, prevents wheels from slipping. When a sensor indicates slippage, the electronic controller applies brake pressure to the slipping wheel. If more than one wheel is slipping, the controller reduces engine power until the wheels stop slipping.

Air brakes use compressed air supplied by a machine called a *compressor*. Most buses, heavy trucks, and trains have air brakes. When the driver or engineer applies the brakes, a storage unit releases compressed air. The air pushes against a piston or diaphragm, which applies brake pressure to pads or shoes. Buses and trucks have disk and drum brakes like those in automobiles. In trains, however, shoes press against the outside of the wheel. William H. Haverdink

See also **Automobile** (The brake system; diagrams).

Bramante, *brah MAHN tay,* **Donato** (1444-1514), was an architect and painter of the Italian Renaissance. Bramante's most famous building is the small circular temple called the Tempietto (1502), at the church of San Pietro in Montoria. The church marks the spot in Rome where, according to tradition, Saint Peter was crucified. Bramante also developed the original designs for St. Peter's Basilica in Rome, and designed the Vatican's Belvedere Courtyard (1505-1513).

Bramante was born near Urbino. After living in Milan for a time, Bramante settled in Rome in 1499. There he studied ancient Roman ruins. Because of his wide knowledge of ancient architecture, he was employed as an architect by Popes Alexander VI and Julius II. J. William Rudd

See also **Saint Peter's Basilica** (History).

SCALA/Art Resource

Bramante's Tempietto, completed in 1502, is modeled on an ancient temple. The church stands in Rome where, according to tradition, Saint Peter was crucified.

Bramble is the name of a group of low, woody shrubs or vines that belongs to the rose family. There are about 300 species. The stems are often prickly. Each of the leaves is divided to form separate blades, or leaflets. The attractive blossoms are white or rose-colored and grow in clusters. Often the berrylike fruits of these plants can be eaten. Blackberry and raspberry plants are types of brambles. See also **Blackberry; Dewberry; Loganberry; Raspberry; Rose.** James L. Luteyn

Scientific classification. Brambles belong to the rose family, Rosaceae. They form the genus *Rubus.*

Bran is the firm outer coat of kernels of barley, corn, oat, rice, wheat, and other cereal grains. It is usually separated from the kernel during milling. Bran has a high fiber content. It also contains iron, niacin and other B vitamins, phosphorus, protein, and starch. Most bran from wheat, the world's chief commercial grain, is used as livestock feed. However, wheat bran is also an ingredient in some breads, muffins, and breakfast cereals. Some researchers believe that the addition of oat bran or rice bran to a person's diet can help lower levels of cholesterol.

Most of the bran produced commercially in the United States is obtained from wheat as a by-product of flour milling. Each wheat kernel also consists of a starchy inner section called the *endosperm* and an

embryo called the *germ*. White flour is made from the endosperm, which is separated during milling. In milling, the kernels are *tempered* (moistened) to make the bran easier to remove. Rollers then grind the grain into finer and finer particles. At each stage, some endosperm becomes flour and is sifted into bins. After the finest grade of white flour has been obtained, a by-product called *shorts* or *middlings* remains. Shorts consist of bran fragments and bits of germ and endosperm. Shorts are used primarily as livestock feed. Donald J. Reid

See also **Flour** (How white flour is milled); **Wheat** (diagram: Cross section of kernel of wheat).

Brancusi, *brahng KOO zee,* **Constantin** (1876-1957), was a Romanian-born sculptor. He attempted to simplify his sculptures to a basic abstract form, trying to eliminate unnecessary details. Brancusi concentrated on a few subjects, such as the egg, the bird in flight, and the human head and torso. He polished his bronze and marble sculptures to a luster to allow the play of light and reflection. His woodcarvings were inspired by Romanian folk carvings and have rougher surfaces.

Brancusi was born on Feb. 19, 1876, in Pestisani, near Tirgu Jiu . He settled in Paris in 1904. Brancusi's early realistic work shows the influence of French sculptor Auguste Rodin. Brancusi then became inspired by the simplicity of African and prehistoric sculpture. By 1910, he had developed his famous style. Joseph F. Lamb

See also **Sculpture** (picture: Bird in Space).

Brand. See **Cowboy** (The roundup); **Ranching**.

Brand name. See **Trademark**.

Brandeis, *BRAN dys,* **Louis Dembitz,** *LOO ihs DEHM bihts* (1856-1941), was an associate justice of the Supreme Court of the United States from 1916 to 1939. He became known for his struggle for economic, social, and political justice. He joined Oliver Wendell Holmes, Jr., in writing numerous opinions, many of them powerful *dissents* (disagreements with the court's majority). These opinions supported social legislation, free speech, and the right to privacy. Brandeis also became known for his belief that the Supreme Court should not decide on legal issues that can be resolved by Congress.

Brandeis was born on Nov. 13, 1856, in Louisville, Kentucky. After graduation from Harvard, he practiced law in St. Louis, Missouri, and Boston. He was known as the "People's Attorney" because he worked to reform big business and powerful financial institutions. He supported such changes as minimum wages and shorter hours for working women and children. Bruce Allen Murphy

Brandenburg is a state in east-central Germany (see **Germany** [terrain map]). The present-day state of Brandenburg was formerly part of a historical region also called Brandenburg. In 1945, after Germany's defeat in World War II, agreements among the Allies placed the part of Brandenburg east of the Oder and Neisse rivers under Polish control. The remaining part of Brandenburg became part of the Soviet-controlled zone of Germany. The Soviet zone became East Germany in 1949, and the German part of Brandenburg became an East German state. When East and West Germany united in 1990, Brandenburg became one of the new nation's 16 states. John W. Boyer

Brandenburg Gate. See **Berlin** (The city).

Brando, Marlon (1924-), became the leading American actor of his generation. He popularized the *Method* style of acting in the 1950's, which emphasized a strongly psychological technique. Brando first gained fame when he appeared on Broadway in 1947 as Stanley Kowalski in *A Streetcar Named Desire*. Brando became a movie star when he repeated the role in the film version in 1951. He won Academy Awards for best actor in *On the Waterfront* (1954) and *The Godfather* (1972).

Brando was born on April 3, 1924, in Omaha, Nebraska. He first appeared on Broadway in 1944. His first motion picture was *The Men* (1950). His other early films include *The Wild One* (1953), *The Teahouse of the August Moon* (1956), and *The Young Lions* (1958). During the 1960's and 1970's, Brando became known for his liberal political activities, especially his support of civil rights for both blacks and American Indians. Since the early 1970's, he has appeared in only a few movies, notably *Last Tango in Paris* (1973), *Apocalypse Now* (1979), *A Dry White Season* (1989), *The Freshman* (1990), *The Island of Dr. Moreau* (1996), and *The Score* (2001). An autobiography titled *Songs My Mother Taught Me* was published in 1994. Louis Giannetti

Archive Photos

Marlon Brando

See also **Motion picture** (picture: *The Godfather*).

Brandon (pop. 39,716) is the second largest city in Manitoba. Only Winnipeg has more people. Brandon is a service and distribution center in a rich farming area. The city lies on the Assiniboine River. For location, see **Manitoba** (political map).

Most of Brandon's residents are employed in service industries, including government, education, retail, and health care. Food processing and the manufacture of chemicals and fertilizers are the city's chief industrial activities. The city contains the B. J. Hales Museum of Natural History, the Brandon Allied Arts Center, the Commonwealth Air Training Plan Museum, and Brandon University. Brandon has a large complex used for recreational, cultural, agricultural, and convention activities.

Assiniboine Indians lived in what is now the Brandon area before white settlers arrived. The settlers, attracted by the fertile land, came during the late 1870's. In 1881, the Canadian Pacific Railway began to serve the area. Brandon was named for Brandon House, a trading post. Brandon was incorporated as a city in 1882. It served as a supply center for pioneers who established farms on the Canadian prairies. Brandon has a mayor-council government with a city manager. Brian D. Marshall

Brandt, Willy (1913-1992), was elected chancellor of West Germany in 1969. He resigned in 1974, after it was discovered that one of his aides was an East German spy. Brandt denied knowledge of the aide's spy activities, but he accepted full responsibility for the matter. Before serving as chancellor, Brandt had been vice chancellor and foreign minister from 1966 to 1969. He was mayor of West Berlin from 1957 to 1966.

In 1971, Brandt won the Nobel Peace Prize for his efforts to reduce tensions between Communist and non-

Communist nations. Under Brandt, West Germany signed nonaggression treaties with the Soviet Union and other Eastern European nations. He worked to normalize relations between East and West Germany and to reduce tensions between East and West Berlin.

As a youth, Brandt joined the Social Democratic Party and openly opposed the Nazis. In 1933, he fled to Norway to escape arrest by them. He worked as a correspondent for Scandinavian newspapers from 1933 to 1945 and was active in anti-Nazi resistance. He returned to Germany after World War II and was elected to the *Bundestag* (lower house of parliament) in 1949.

Brandt was born Herbert Ernst Karl Frahm in Lübeck, Germany. He changed his name when he fled from the Nazis in Germany. Klaus Liepelt

Branson (pop. 6,050), a town in the Ozark Mountains of southwest Missouri, ranks as a world center of country and contemporary music. About 5 million people visit the town annually. Performances of country and other music are the main attraction. Theme parks, shopping malls, and outdoor activities in the area also draw many visitors. For location, see **Missouri** (political map).

Branson began in 1882 with a general store and post office serving a few families. Its first economic boom came in 1906, when a railroad reached it, and in 1907, when *The Shepherd of the Hills* was published. This book by Harold Bell Wright praised the natural beauty and caring people of the Ozarks, and attracted visitors. Branson was incorporated in 1912 and has a mayor-council form of government. The Powersite Dam, completed in 1913, created Lake Taneycomo. By the 1930's, Lake Taneycomo had become a popular vacation spot. The completion of Table Rock Dam in 1958 created Table Rock Lake. Fishing and water recreation increased in the area. In the 1960's and 1970's, music theaters, motels, and restaurants were established for the growing tourist trade. Branson's biggest boom began in 1983, when it started attracting country music stars. During the 1990's, many contemporary musicians also began performing in Branson. Stephen Kneeshaw

See also **Missouri** (picture).

Brant, also spelled *brent,* is the name of two wild North American geese. Both are sea geese and are usually seen on or near salt water. One is the *white-bellied brant.* It is about 23 to 30 inches (53 to 76 centimeters) long and weighs 3 to 4 pounds (1.3 to 1.8 kilograms). It resembles the Canada goose, but is smaller and has black feathers on its head, neck, and upper breast. Its back is brownish-gray. The lower part of the body is ash colored and white. The female brant lays from four to eight whitish eggs in a nest on the ground. White-bellied brants fly from the eastern Arctic to winter along the Atlantic Coast of the United States.

The *black brant* is much like the white-bellied brant, but it has black on the underside of the body as well as on the head and neck. It breeds in the Arctic but winters on the Pacific Coast. Charles Walcott

Scientific classification. Brants belong to the family Anatidae. Some biologists classify the white-bellied brant as *Branta bernicla* and the black brant as *B. nigricans.* But others consider both to be subspecies of *B. bernicla.*

© Steven Kaufman, Bruce Coleman Ltd.

The black brant is a wild sea goose that breeds in the Arctic but spends its winters on the Pacific Coast of North America.

Brant, Joseph (1742-1807), was a Mohawk Indian leader. His Indian name was Thayendanegea. He led the Iroquois forces that fought on the side of the British in the Revolutionary War in America (1775-1783). Brant became a colonel in the British Army, and his raids on settlements in the Mohawk Valley caused great damage.

Brant was born in what is now Ohio. As a young man, he sided with the Iroquois who fought for the British against the French. Brant became a friend of the British general Sir William Johnson. As a result of this friendship, Brant attended the Eleazer Wheelock Academy in Lebanon, Connecticut, and became a Christian.

Until the Revolutionary War began, Brant had served as a missionary among his people. He translated the Episcopal Prayer Book and part of the New Testament into Mohawk. After the war, Brant continued his missionary work in Canada. Robert E. Powless

Braque, *brahk,* **Georges** (1882-1963), was a French artist. In the early 1900's, Braque and Pablo Picasso led the development of Cubism, a painting style that had a major influence. Braque and other Cubist artists tried to portray the basic geometric forms of subjects. The subjects in many Cubist paintings are almost unrecognizable. Braque's *Man with a Guitar,* reproduced in the **Cubism** article, is an excellent example. Another Cubist work, *Violin and Palette,* appears in the **Painting** article.

Braque was an early creator of *collages.* He glued bits of cloth, newspaper, and other materials to paintings to enrich the design (see **Collage**). He also used a painting technique that imitated surface textures such as marble and the grain of wood. Braque painted pictures with elements of the Cubist style his entire life. For example, from 1949 to 1956, he painted eight large pictures of studio interiors that show his ability to arrange objects in delicate relationships in space.

Braque was born in Argenteuil and studied in Le Havre. His early pictures reflect the style of the French artist Paul Cézanne. Braque was also influenced by the sharply chiseled geometric features of black African sculpture. Alison McNeil Kettering

Brasília, *brah SEEL yuh* (pop. 1,803,478), is the capital of Brazil and one of the world's leading examples of large-scale city planning. Brazil's government began to build Brasília on a nearly barren site in the 1950's. The city's construction in central Brazil, northwest of the former capital, Rio de Janeiro, was designed to encourage the development of Brazil's interior. Today, the city is noted for its modern architecture and broad thorough-

Claus Meyer, Black Star

Brasília is noted for its modern architecture. The Congress buildings include twin towers, *foreground,* that house congressional offices. The Chamber of Deputies meets in a bowl-shaped structure, *left,* and the Senate meets in a domed building, *right.* Other government and commercial buildings and a crown-shaped cathedral are in the background.

fares. For location, see **Brazil** (political map).

The city is laid out in a pattern that, when viewed from the air, resembles the shape of a drawn bow and arrow. Federal government buildings stand near the east end of Brasília, at the tip of the arrow. This area, called the Plaza of the Three Powers, includes buildings that house the president's office, Congress, and the Supreme Court. A large artificial lake lies east of the plaza, and the University of Brasília is nearby.

A wide boulevard lined with attractive buildings runs west from the Plaza of the Three Powers. Business, cultural, and recreational districts, as well as a bus terminal, are in the city's center. Farther west along the arrow's shaft are areas that include a complex of hotels, a sports arena, and fairgrounds.

Residential areas run north and south along the curve of the bow. Rows of six-story apartment buildings house government employees and their families. Each group of four buildings has its own shops, theaters, playgrounds, and elementary school.

An unplanned community called *Pioneer Center* lies alongside the planned city. A sprawling suburb of wooden homes with a frontier atmosphere, Pioneer Center was built by laborers who migrated to Brasília to work on the capital's construction. In addition, several other suburbs have sprung up around Brasília.

Economy. Most workers in Brasília are employed by the federal government. Other major industries include construction and commerce.

History. Proposals to move Brazil's capital inland began in the early 1800's. Juscelino Kubitschek, president of Brazil from 1955 to 1960, was the leading force behind the construction of Brasília. Construction of the city began in 1956. The Brazilian architect Lúcio Costa developed the city plan. Oscar Niemeyer, another Brazilian architect, designed many of the city's modernistic buildings.

The capital was moved from Rio de Janeiro to Brasília on April 21, 1960. The government has built highways to link Brasília with the rest of the country. These new transportation routes have helped bring commerce and settlement to Brazil's interior. Nathan A. Haverstock

See also **Brazil** (pictures); **Niemeyer, Oscar.**

Brass is an *alloy* (mixture) of copper and zinc. Other elements may be added to the alloy for special uses. Brass is widely used in making hardware, electrical fixtures, inexpensive jewelry, metal decorations, military supplies, and musical instruments.

The amount of copper used in brass ranges from 55 percent to more than 95 percent. The color and properties of brass vary with its composition. When the alloy contains about 70 percent copper, it has a golden yellow color and is known as *yellow* brass, *high* brass, or *cartridge* brass. When it contains 80 percent or more copper, it has a reddish copper color and is known as *red* brass or *low* brass. *Muntz metal* contains 60 percent copper and 40 percent zinc. Alloys that have a high copper content are almost as soft as pure copper. But as zinc is added, they become stronger and tougher. Compositions of 55 percent copper and 45 percent zinc are hard and somewhat brittle.

To obtain special properties, brass makers often add other elements to the copper-zinc alloy. Lead is added to improve *machinability* (ease of cutting). The result is called *leaded* brass. Brass that contains 1 percent to 3 percent lead can be machined easily and is often used to make parts for clocks and other precision equipment. Tin and nickel are often added to increase the alloy's resistance to corrosion or wear. Naval brass contains 1 percent tin. Nickel can be added to obtain a silvery-white color that makes the alloy a more suitable base for silver plating. Silver-plated flatware and hollowware often have a brass base. Other elements added to brass are iron, aluminum, and manganese. Aluminum helps prevent seawater from corroding brass.

Making brass. The first step in making brass is to melt copper in an electric furnace. Solid pieces of zinc are then added to the melted copper. The zinc melts rapidly. A covering of charcoal is often placed over the liquid metals to reduce the loss of heat and to prevent an excessive loss of zinc by vaporization (see **Vapor**). After the copper and zinc have been melted and thoroughly mixed, the brass is ready for pouring. It can be poured directly into forms to cast the wanted articles, or it can be made into bars called *billets.* Such bars make it easier to work with the brass or to store it. Workers may cut off the top of the brass bar. This portion, which became solid last, contains impurities and is porous. The billet is then placed in another furnace and reheated until it reaches the proper temperature for working.

Some uses of brass

Brass is widely used in making pitchers and other hollowware. Some marine hardware is made of manganese brass. Brass screws are made of a tin-brass alloy, which resists corrosion and wear. Trombones and other musical instruments are made of *cartridge* (high zinc content) brass.

WORLD BOOK photo by Milt Mann

Brass pitcher

Martin Rogers, Woodfin Camp, Inc.

Marine hardware

WORLD BOOK photo by Milt Mann

Brass screw

© Pamella McReynolds

Trombone

After the reheating process, the brass can be rolled while it is still hot, and formed into the desired shape. A milling machine removes surface imperfections. The brass is then cold-rolled.

Almost any method for shaping metal can be used to shape brass. It can be rolled into sheets and plates; drawn or *extruded* (squeezed out) into rods, tubes, and wire; forged or pressed into complicated shapes; and spun to form deep *receptacles* (containers).

Brass articles are free from dirt, gas, and other defects, so they can be polished to a brilliant finish. Brass objects often are electroplated (see **Electroplating**). Their surfaces are easily treated to obtain beautiful and useful effects.

History. Both brass and bronze, the alloy of copper and tin, were probably first made accidentally when people heated copper ores that contained the alloying metals. But brass did not have the importance of bronze in ancient times. Brass was harder to produce because the zinc in brass, unlike the tin in bronze, evaporates soon after melting and is lost.

Brass was first used extensively by the Romans about 2,000 years ago. They made brass coins, kettles, and ornaments. Sara Steck Melford

See also **Alloy; Bronze; Copper; Wire; Zinc.**

Bratislava, *BRAH tih slah vuh,* or Pressburg (pop. 409,100), is the capital and largest city of Slovakia. It lies on the Danube River 35 miles (56 kilometers) east of Vienna, Austria (see **Slovakia** [map]). Railway and river traffic meet at Bratislava. Factories there make chemicals, cloth, machinery, and petroleum products. Bratislava's landmarks include St. Martin's Cathedral, in the downtown area; and Bratislava Castle, which overlooks the city from a hill nearby. Bratislava is the home of Comenius University.

Bratislava was chartered in 1291. It served as the capital of Hungary from 1536 to 1683. In 1918, the city became the capital of Slovakia, a province of the new nation of Czechoslovakia. In 1968, Bratislava was named the capital of the Slovak Socialist Republic of Czechoslovakia. In 1993, Slovakia became an independent country. Bratislava remained the capital of the country.

Vojtech Mastny

Brattain, *BRAT uhn,* **Walter Houser** (1902-1987), an American physicist, helped invent the transistor. He shared the 1956 Nobel Prize in physics with John Bardeen and William Shockley for discovering principles of electrical conduction in solids that make transistors possible (see **Transistor**).

Brattain was born in Xiamen, China. He graduated from Whitman College and the universities of Oregon and Minnesota. He worked at the Bell Telephone Laboratories. Spencer R. Weart

Braun, Carol Moseley. See Moseley-Braun, Carol.

Braun, *brown,* **Eva,** *EE vuh* or *AY vah* (1912-1945), was the mistress of Adolf Hitler, dictator of Germany from 1933 to 1945. Braun met Hitler in Munich in 1929 while working as an assistant to Heinrich Hoffmann, Hitler's personal photographer. Hitler gave her a suite of rooms in his personal residence. Braun had no influential or political role in government, and she never sought to interfere in Hitler's work or official activities. She made few demands on Hitler and was totally devoted to him. Hitler made her wealthy and kept her out of public view.

European Picture Service

Eva Braun

Eva Braun was born in Munich, Germany, to a middle-class Bavarian couple. She married Hitler near the end of World War II, on April 29, 1945, in a bomb shelter in Berlin. The next day, as Soviet troops closed in on the place where they were hiding, both Braun and Hitler committed suicide.

Charles W. Sydnor, Jr.

Braun, Wernher von. See Von Braun, Wernher.

Braxton, Carter (1736-1797), an American statesman, was a Virginia signer of the Declaration of Independence. He was born in Newington, Va., the son of a wealthy planter, and attended the College of William and Mary. He served in the House of Burgesses (the Virginia legislature) from 1761 to 1771 and again in 1775. He was a member of the Continental Congress in 1776. He was strongly criticized for proposing that Virginia's governor and senators should hold office for life unless convicted of a crime. Jack N. Rakove

© José Fuste Raga, The Stock Market

São Paulo is the commercial and industrial center of Brazil and one of the largest cities in the world in population. This bustling area of downtown São Paulo includes modern high-rise buildings and the elegant Municipal Theatre, *left,* which was completed in 1911.

Brazil

Brazil, *bruh ZIHL,* is the largest country in South America in both area and population. It occupies almost half the continent and has more people than all the other South American nations combined. Brazil ranks fifth in both area and population among the countries of the world.

Brazil has a varied landscape. The world's largest tropical rain forest sprawls across much of the north. The mighty Amazon and other enormous rivers wind through this vast green area of towering trees and steamy jungles. Cloud-capped mountains rise north of the forests and border the Atlantic Ocean in the southeast. Dry plains extend across parts of northeastern Brazil. The low plateaus of central and southern Brazil have fertile farmlands and lush grazing areas. Broad, white beaches line glistening seashores on the nation's long Atlantic coast.

The forests, rivers, and mountains of Brazil have long hindered travel inland, and the country's vast interior remains little developed. About 80 percent of all Brazilians live within 200 miles (320 kilometers) of the Atlantic coast. Nearly all of Brazil's big cities and towns are on or near the coast. One of the largest cities in Brazil's interior is Brasília. Brasília is also the capital of the country. The city was built about 600 miles (970 kilometers) from the coast to help draw Brazilians inland.

São Paulo and Rio de Janeiro are the country's two largest cities. São Paulo is one of the largest cities in the world in terms of population. This modern, fast-paced urban area is also Brazil's chief commercial and industrial center. Rio de Janeiro, often called simply Rio, is one of the most densely populated cities in South America. Rio is a major tourist attraction. The city is known throughout the world for its breathtaking coastline, exciting nightclubs, and colorful festivals.

Brazil's people come from many backgrounds. About half the country's population are of European ancestry—mostly German, Italian, Portuguese, and Spanish. Many other Brazilians are of mixed African and European ancestry, and some are of only African descent. Indians, the original Brazilians, form less than 1 percent of Brazil's people.

Rich natural resources have helped make Brazil a growing economic power. The nation is the world's largest "coffeepot," producing about a fifth of the total coffee crop each year. Brazil ranks among the world's leading countries in the production of a wide variety of agricultural items, including bananas, cacao beans, cattle, corn, cotton, horses, lemons, oranges, pineapples, rice, soybeans, sugar cane, and tobacco. Huge supplies of nuts, timber, and other products come from its forests, and power plants on its rivers generate a great amount of electric power. Brazil produces large quantities of iron ore, manganese, and many other minerals needed by industry.

Rapid industrial growth during the mid-1900's helped Brazil become one of the world's top manufacturing nations. Brazil has the largest steel plant in Latin America, and the manufacture of metal products is the nation's chief industrial activity. In addition, Brazil ranks among the world's leading countries in the manufacture of automobiles.

In spite of Brazil's productive economy, the great wealth of some Brazilians contrasts sharply with the great poverty of others. A small number of landowners, executives, and government leaders live in luxury. A small but fast-growing group of middle-class Brazilians, including business managers, government workers, and

J. H. Galloway, the contributor of this article, is Professor of Geography at the University of Toronto.

Brazil in brief

General information

Capital: Brasília.
Official language: Portuguese.
Official name: República Federativo do Brasil (Federative Republic of Brazil).
Largest cities: (1990 official estimates)

São Paulo (11,128,848)	Brasília (1,803,478)
Rio de Janeiro (6,042,411)	Nova Iguaçu (1,511,915)
Belo Horizonte (2,145,908)	Curitiba (1,398,599)
Salvador (2,050,133)	Pôrto Alegre (1,386,828)
Fortaleza (1,824,911)	Recife (1,375,404)

The Brazilian flag bears the motto *Order and Progress.* The green and golden-yellow colors symbolize forests and minerals. Blue and white are Portugal's historic colors.

Brazil's coat of arms commemorates the birth of the republic on Nov. 15, 1889. Branches of coffee and tobacco, two important crops, surround the central emblem.

Land and climate

Land: Brazil is the largest country in South America. It extends over almost half the continent and borders 10 other countries. The world's largest rain forest spreads across much of northern Brazil, and the Amazon and other mighty rivers wind through this region. Majestic mountains rise north of the forests and border the Atlantic Ocean in the southeast. Dry plains stretch across parts of the northeast. The low plateaus of central and southern Brazil form a rich agricultural region. Broad white beaches line seashores on the nation's long Atlantic coast.

Area: 3,300,171 mi² (8,547,403 km²). *Greatest distances*—north-south, 2,684 mi (4,319 km); east-west, 2,689 mi (4,328 km). *Coastline*—4,600 mi (7,400 km).
Elevation: *Highest*—Pico da Neblina, 9,888 ft (3,014 m) above sea level. *Lowest*—sea level.
Climate: Most of the country has a warm to hot climate the year around. The mountains, plateaus, and some coastal areas are cooler than the lowlands. For example, Menaus, in the central Amazon region, has an average annual temperature of 81 °F (27 °C). But São Paulo, on a plateau, has an average daily temperature of about 73 °F (23 °C) in January and about 60 °F (16 °C) in July. Rain falls heavily in much of Brazil. The western Amazon region receives over 160 inches (400 centimeters) of rainfall a year.

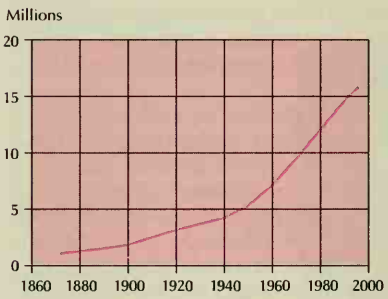
Government

Form of government: Federal republic.
Head of state and head of government: President.
Legislature: Congress of two houses—the Chamber of Deputies (503 members) and the Senate (81 members).
Executive: President (elected by people to four-year term).
Judiciary: Highest court is the Supreme Federal Court.
Political subdivisions: 26 states, 1 federal district.

People

Population: *Estimated 2002 population*—174,222,000. *1991 census*—146,825,475.
Population density: 53 per mi² (20 per km²).
Distribution: 78 percent urban, 22 percent rural.
Major ethnic/national groups: About 55 percent of European descent, including Germans, Italians, Poles, Portuguese, and Spaniards. About 6 percent of African descent. About 38 percent of mixed African and European descent. About 1 percent American Indian and other.
Major religions: About 70 percent Roman Catholic and about 20 percent Protestant.

Population trend



Year	Population
1872	9,930,000
1890	14,334,000
1900	17,438,000
1920	30,636,000
1940	41,236,315
1950	51,944,000
1960	70,070,000
1970	93,139,000
1980	119,003,000
1991	146,825,000
1996	157,080,000

Economy

Chief products: *Agriculture*—bananas, cacao beans, cassava, cattle, chickens, coffee, oranges, rice, soybeans, sugar cane, tobacco. *Manufacturing and processing*—automobiles, cement, chemicals, electrical equipment, food products, machinery, paper, rubber, steel, textiles, trucks. *Mining*—bauxite, coal, diamonds, gold, iron ore, manganese, petroleum, phosphates, platinum, tin, uranium. *Forest products*—Brazil nuts, carnauba wax, latex, timber. *Fishing*—characins, croakers, lobster, sardinellas, shrimp.
Money: *Basic unit*—real. One hundred centavos equal one real.
Foreign trade: *Major exports*—aluminum, coffee, iron ore, iron and steel, meat, oranges and orange juice, shoes, soybeans and soy meal, sugar, transportation vehicles and parts. *Major imports*—chemicals, fertilizer, machinery, petroleum, wheat. *Major trading partners*—Argentina, Canada, France, Germany, Italy, Japan, Mexico, the Netherlands, Paraguay, Saudi Arabia, the United Kingdom, the United States, Uruguay.

teachers, live comfortably. But most Brazilians are poor. Many live in rural areas continually troubled by drought and floods. Many others live in crowded city slums.

Brazil shares many traditions with Portugal. It was a Portuguese colony from 1500 to 1822 and is the only Portuguese-speaking nation in Latin America. The early Portuguese colonists also brought Roman Catholicism to Brazil. Today, Brazil has more Catholics than any other nation.

Brazil has been a republic since 1889. It has had periods of dictatorial rule, as well as many years of representative government.

For population and other key statistics, see the *Brazil in brief* feature that appears in this article.

Government

Brazil is a republic with a strong national government. It has 26 states and 1 federal district. The federal district consists of Brasília, the capital.

Brazil's federal government has three branches. They are (1) an executive branch headed by a president, (2) a legislative branch called the Congress, and (3) a judicial branch, or court system.

Except for enlisted men and women in the armed forces, all Brazilian adults who can read and write are eligible to vote in elections. The minimum voting age is 16. For 16- and 17-year-olds, voting is optional. The law requires all qualified voters aged 18 to 70 to vote. Voting is optional for qualified voters over 70.

National government. The president is elected by the people to a four-year term. The president may not be elected to more than two terms in a row.

Brazil's Constitution gives the president tremendous powers, however. For example, the president may intervene in affairs of Brazil's states.

Brazil's Congress consists of an 81-member Senate and a 503-member Chamber of Deputies. Brazil's 26 states and the federal district elect 3 senators each. Senators serve eight years. The number of deputies from each state and from the federal district varies, depending on population, but none has fewer than 3 deputies. Deputies serve four-year terms. Senators and deputies may be reelected to any number of terms.

Local government. Each state has a governor and legislature elected by the people. The states are divided into districts called *municípios*. An elected mayor and lawmaking body govern each município. A governor appointed by the country's president administers the federal district.

Politics. Brazil has a number of political parties. Among the largest are the Brazilian Democratic Movement Party, the Brazilian Social Democracy Party, the Liberal Front Party, and the Workers' Party. The Brazilian Democratic Movement Party is a moderate party that consists of a loose *coalition* (combination) of politicians with a wide range of political views. The Brazilian Social Democracy Party is a center-left party that favors both a free-market economy and greater government involvement in education, health care, and other social services. The Liberal Front Party, a center-right party, has strong support in northeastern Brazil and in the Amazon region. The Workers' Party is a liberal party.

In addition, smaller parties represent the special interests of business, labor, and other groups. Some of these parties center on popular leaders instead of particular issues.

© Björn Klingwall

Government buildings in Brasília, Brazil's capital, are noted for their modern architecture. The senators and deputies of the Brazilian national legislature have offices in striking twin towers, *center*. The Senate meets in a domed structure, *left*, and the Chamber of Deputies meets in a bowl-shaped building, *right*.

Courts. The Supreme Federal Court is Brazil's highest court. It has 11 justices. The president appoints them for life terms with the Senate's approval. The states and the federal district all have lower federal courts. Each state also has local courts.

Armed forces. Brazil has the largest military force in Latin America. The army has about 200,000 members; the navy, about 65,000; and the air force, about 50,000. Brazilian men between 18 and 45 years of age may be drafted for 12 months of service.

People

Population. Brazil ranks as the world's fifth largest nation in population. Only China, India, the United States, and Indonesia have more people. About half the people of South America live in Brazil.

The population of Brazil is unevenly distributed. About 80 percent of Brazil's people live within 200 miles (320 kilometers) of the Atlantic coast. By contrast, only about 7 percent live in the Amazon Region in northwestern and north-central Brazil. This region is larger than the United States west of the Mississippi River, but thick forests cover most of it.

Various economic developments have influenced patterns of settlement in Brazil. During the mid-1500's, many Portuguese colonists came to northeastern Brazil and established large sugar cane plantations. The discovery of gold and diamonds in east-central Brazil in the 1690's and early 1700's drew settlers to that region.

During the 1800's, the production of coffee in southeastern Brazil offered the chief hope for people seeking economic opportunity in Brazil, and large numbers of Brazilians and European immigrants rushed there. In the late 1800's, many Japanese immigrants began to come to that area to grow coffee, cotton, and tea. About 1870, a rubber boom in the Amazon Region drew a wave of

Brazil map index

States

Map key	Name	Population	Area In sq. mi.	Area In km²
D 1	Acre	435,000	59,343	153,698
D 9	Alagoas	2,522,000	11,238	29,107
B 6	Amapá	268,000	54,965	142,359
C 3	Amazonas	2,214,000	605,390	1,567,954
E 8	Bahia	12,175,000	218,912	566,979
C 9	Ceará	6,667,000	57,559	149,076
F 7	Distrito Federal	1,803,478	2,237	5,794
G 9	Espírito Santo	2,635,000	17,658	45,733
F 6	Goiás	4,288,000	131,339	340,166
C 7	Maranhão	5,275,000	127,242	329,556
E 5	Matu Grosso	2,118,000	348,041	901,421
G 5	Mato Grosso do Sul	1,881,000	138,021	357,472
G 7	Minas Gerais	16,855,000	226,497	586,624
C 6	Pará	5,392,000	481,405	1,246,833
D 10	Paraíba	3,420,000	20,833	53,958
H 6	Paraná	9,342,000	76,959	199,324
D 9	Pernambuco	7,603,000	39,005	101,023
D 8	Piauí	2,800,000	97,017	251,273
H 8	Rio de Janeiro	14,062,000	16,855	43,653
C 9	Rio Grande do Norte	2,451,000	20,528	53,167
I 5	Rio Grande do Sul	9,450,000	108,369	280,674
E 3	Rondônia	1,125,000	92,039	238,379
B 4	Roraima	136,000	86,880	225,017
I 6	Santa Catarina	4,602,000	36,802	95,318
G 7	São Paulo	33,516,000	95,852	248,256
E 9	Sergipe	1,516,000	8,441	21,863
D 7	Tocantins	1,012,000	107,075	277,322

Cities and towns

Alagoinhas ..... 129,049 . E 9
Altamira* ..... 156,217 . C 6
Alvorada* ..... 116,985 . I 6
Americana* ..... 179,447 . H 7
Ananindeua* ..... 214,910 . B 7
Anápolis ..... 258,654 . F 6
Apucarana ..... 102,322 . H 6
Aracaju ..... 418,671 . E 9
Araçatuba ..... 157,629 . G 6
Araguaiana* ..... 107,071 . F 6
Araguari* ..... 108,227 . G 8
Arapiraca ..... 181,420 . E 9
Araraquara ..... 157,691 . G 7
Bacabal ..... 102,676 . C 7
Bagé ..... 116,433 . J 5
Barbacena ..... 119,469 . G 8
Barra do Corda* ..... 107,994 . D 8
Barra Mansa* ..... 214,918 . H 8
Barueri* ..... 117,345 . H 7
Bauru ..... 242,810 . H 6
Belém 1,203,151
†1,418,061 . B 7
Belo Horizonte 2,145,908
†3,615,234 . G 8
Betim* ..... 119,771 . G 7
Blumenau ..... 220,741 . I 6
Bragança ..... 115,465 . B 7
Bragança Paulista* ..... 119,388 . H 7
Brasília ..... 1,803,478 . F 7
Cabo* ..... 142,633 . D 10
Cáceres ..... 101,881 . F 4
Cachoeiro de Itapemirim ..... 146,722 . G 8
Camaçari* ..... 101,881 . E 9
Camaragibe* ..... 142,633 . D 10
Cameta* ..... 103,035 . C 7
Campina Grande ..... 311,031 . D 10
Campinas ..... 960,801 . H 7
Campo Grande ..... 459,554 . G 5
Canoas ..... 292,613 . I 6
Carapicuíba* ..... 320,188 . H 7
Caratinga* ..... 120,430 . G 8
Cariacica* ..... 282,887 . G 8
Caruaru ..... 209,780 . D 10
Cascavel ..... 197,407 . H 5
Castanhal ..... 108,287 . B 7
Caucaia* ..... 121,424 . C 9
Caxias ..... 175,347 . C 8
Caxias do Sul ..... 302,992 . I 6
Chapecó ..... 119,716 . I 6
Codo ..... 129,827 . C 8
Colatina ..... 109,033 . G 8
Contagem* ..... 478,522 . G 8
Coronel Fabriciano* ..... 105,486 . G 8
Criciuma ..... 134,116 . I 6
Cubatão* ..... 117,665 . H 7
Cuiabá ..... 349,416 . F 5
Curitiba 1,398,599
†1,966,426 . H 6
Diadema* ..... 382,319 . H 7
Divinópolis ..... 165,777 . G 7
Dourados ..... 156,217 . G 5
Duque de Caxias* ..... 739,699 . H 8
Embu* ..... 142,633 . H 7
Feira de Santana ..... 409,941 . E 9
Florianópolis ..... 242,861 . I 6
Fortaleza 1,824,911
†2,119,774 . C 9
Foz do Iguaçu* ..... 199,731 . H 6
França ..... 205,786 . G 7
Garanhuns ..... 119,848 . D 9
Goiânia ..... 1,064,567 . F 6
Governador Valadares ..... 236,021 . G 8
Gravataí* ..... 163,488 . J 6
Guarapuava ..... 170,149 . H 6
Guaratinguetá* ..... 102,774 . H 7
Guarujá* ..... 209,708 . H 7
Guarulhos* ..... 836,359 . H 7
Ilhéus ..... 159,395 . F 9
Imperatriz ..... 276,350 . C 7
Itaborai* ..... 169,717 . H 8
Itabuna ..... 186,294 . F 9
Itaguaí* ..... 119,209 . H 8
Itaituba* ..... 156,217 . C 6
Itajaí ..... 119,356 . I 6
Itapetininga* ..... 119,857 . H 7
Itapinga* ..... 270,196 . G 7
Itaquaquecetuba* ..... 104,633 . H 7
Itu* ..... 105,867 . H 7
Ituiutaba ..... 101,881 . G 6
Jaboatão* ..... 491,774 . D 9
Jacareí* ..... 183,696 . H 7
Jaú* ..... 105,594 . H 7
Jequié ..... 145,939 . F 9
João Pessoa ..... 459,954 . D 10
Joinville ..... 358,094 . I 6
Juàzeiro ..... 156,217 . D 9
Juàzeiro do Norte ..... 181,157 . D 9
Juiz de Fora ..... 388,310 . G 8
Jundiaí* ..... 350,882 . H 7
Lajes ..... 159,775 . I 6
Limeira* ..... 211,713 . H 7
Linhares ..... 147,707 . G 8
Londrina ..... 378,903 . H 6
Luziânia* ..... 118,427 . F 7
Macapá ..... 159,768 . B 6
Maceió ..... 548,015 . D 10
Manaus ..... 1,113,676 . C 4
Marília ..... 158,024 . G 6
Maringá ..... 215,237 . H 6
Mauá* ..... 312,486 . H 7
Mogi das Cruzes ..... 258,663 . H 7
Mogi-Guaçu* ..... 104,963 . H 7
Montes Claros ..... 247,240 . F 8
Mossoró ..... 182,497 . C 9
Muriaé ..... 50,040 . G 8
Natal ..... 600,214 . D 10
Nilópolis* ..... 178,332 . H 8
Niterói ..... 479,834 . H 8
Nova Friburgo ..... 160,781 . H 8
Nova Iguaçu ..... 1,511,915 . H 8
Nôvo Hamburgo* ..... 192,188 . I 6
Olinda* ..... 389,244 . D 10
Osasco* ..... 671,011 . H 7
Ourinhos ..... 52,698 . H 6
Paranaguá ..... 116,163 . H 6
Paranavaí ..... 52,654 . H 6
Parnaíba ..... 132,960 . C 8
Passo Fundo ..... 158,722 . I 6
Patos ..... 58,735 . D 9
Patos de Minas ..... 119,506 . G 7
Paulo Afonso ..... 101,881 . D 9
Pelotas ..... 294,420 . J 6
Petrolina ..... 164,222 . D 9
Petrópolis ..... 286,402 . H 8
Piracicaba* ..... 277,721 . H 7
Poços de Caldas* ..... 119,389 . G 7
Ponta Grossa ..... 244,056 . H 6
Pôrto Alegre 1,386,828
†2,906,472 . J 6
Pôrto Velho ..... 227,902 . D 3
Presidente Prudente ..... 169,365 . G 6
Recife 1,375,404
†2,814,795 . D 10
Ribeirão Prêto ..... 426,966 . G 7
Rio Branco ..... 175,086 . E 2
Rio Claro ..... 144,334 . H 7
Rio de Janeiro 6,042,411
†11,205,567 . H 8
Rio Grande ..... 178,385 . J 6
Rondonópolis ..... 129,049 . F 5
Salvador 2,050,133
†2,424,878 . E 9
Santa Bárbara d'Oeste* ..... 109,327 . H 7
Santa Cruz do Sul* ..... 130,951 . I 6
Santa Maria ..... 205,735 . I 5
Santarém ..... 242,994 . C 5
Santo André ..... 690,830 . H 7
Santos ..... 486,810 . H 7
São Bernardo do Campo ..... 655,403 . H 7
São Caetano do Sul* ..... 189,524 . H 7
São Carlos* ..... 158,313 . H 7
São Gonçalo* ..... 825,338 . H 8
São João de Meriti* ..... 508,221 . H 8
São José do Rio Prêto ..... 256,797 . G 6
São José dos Campos* ..... 430,326 . H 7
São Leopoldo* ..... 130,971 . I 5
São Luis ..... 641,983 . C 8
São Paulo 11,128,848
†17,112,712 . H 7
São Vicente* ..... 271,528 . H 7
Sapucaia do Sul* ..... 103,302 . I 5
Serra* ..... 142,633 . G 8
Sete Lagoas ..... 156,217 . G 7
Sobral ..... 132,456 . C 9
Sorocaba ..... 366,557 . H 7
Susano* ..... 148,053 . H 7
Taubaté* ..... 229,465 . H 7
Taboão da Serra* ..... 144,993 . H 7
Teófilo Otoni ..... 129,253 . G 8
Teresina ..... 556,364 . C 8
Teresópolis* ..... 130,549 . H 8
Timon ..... 104,791 . C 8
Tubarão ..... 64,585 . I 6
Uberaba ..... 286,650 . G 7
Uberlândia ..... 377,026 . G 7
Umuarama ..... 101,909 . H 5
Uruguaiana ..... 117,098 . I 5
Varginha ..... 57,448 . G 7
Várzea Grande* ..... 142,633 . F 5
Viamao* ..... 185,871 . J 6
Vila Velha ..... 288,611 . G 8
Vitória ..... 286,953 . G 8
Vitória da Conquista ..... 221,810 . F 8
Vitória de Santo Antão* ..... 115,465 . D 9
Volta Redonda ..... 248,786 . H 7

*Does not appear on map; key shows general location.
†Population of metropolitan area, including suburbs.
Sources: 1990 official estimates; 1980 census for places with populations below 70,000.

4
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A
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J
60°
50°
40° West Longitude
20° South Latitude
North Atlantic Ocean
South Atlantic Ocean
GUYANA
SURINAME
FRENCH GUIANA
Mahdia
Nieuw Nickerie
Paramaribo
Brownsweg
Cayenne
Essequibo
Courantyne
CABO ORANGE N.P.
Amapá
Amapá
Macapá
Mazagão
Jari
Trombetas
Monte Dourado
Marajó Island
Marajo Estuary
Castanhal
Bragança
Capanema
Belém
Abaetetuba
Driximiná
Alenquer
Amazon
Monte Alegre
Santarém
Parintins
Manaus
Itacoatiara
Manacapuru
Xingu
Pará
Tocantins
São Luís
São Marcos Bay
Parnaíba
Camocim
SETE CIDADES N.P.
Sobral
Fortaleza
Rocas Atol
UBAJARA N.P.
Bacabal
Codó
Piripiri
Caxias
Campo Maior
Pedreiras
Maranhão
Timon
Teresina
Russas
Mossoró
Ceará
Tucuruí Reservoir
AMAZÔNIA N.P.
Pará
Marabá
Imperatriz
Tapajós
Tocantinópolis
Boa Esperança Reservoir
Mearim
Floriano
Rio Grande do Norte
Natal
Pau dos Ferros
Currais Novos
Iguatu
Juàzeiro do Norte
Sousa
Caicó
Guarabira
Crato
Picos
Patos
Paraíba
João Pessoa
Carolina
Balsas
Brejo Santo
Campina Grande
Salgueiro
Pernambuco
Arcoverde
Caruaru
Recife
Aripuanã
Teles Pires
North
Iriri
Xingu
Conceição do Araguaia
Araguaia
Tocantins
Parnaíba
Piauí
Palmares
Casa Nova
PAULO AFONSO N.P.
Santana do Ipanema
Garanhuns
Petrolina
Palmeira dos Índios
Juàzeiro
Paulo Afonso
Alagoas
Maceió
Arapiraca
Penedo
Roosevelt
Miracema do Norte
Tocantins
ARAGUAIA N.P.
Pôrto Nacional
Sobradinho Reservoir
Juruena
BRAZIL
Barra
Senhor do Bonfim
Sergipe
Aracaju
Jacobina
Estância
Dianópolis
Bahia
Barreiras
Feira de Santana
Alagoinhas
Itaberaba
Salvador
Todos os Santos Bay
Guaporé
Mato Grosso
Mortes
Araguaia
Porangatu
CHAPADA DOS VEADEIROS N.P.
São Francisco
Bom Jesus da Lapa
Jequié
Ipiaú
Posse
Distrito Federal
Ceres
Vitória da Conquista
Ilhéus
Itabuna
Paraguai
Cuiabá
Barra do Garças
BRASÍLIA N.P.
Formosa
Januária
Cáceres
Itapetinga
São Luís dos Montes Belos
Brasília
Almenara
Rondonópolis
Anápolis
Goiânia
Montes Claros
Jequitinhonha
Goiás
Pires do Rio
Pirapora
MONTE PASCOAL N.P.
Jataí
Taquari
Teófilo Otoni
Nanuque
EMAS N.P.
Itumbiara
Diamantina
Caravelas
Corumbá
Patos de Minas
Minas Gerais
Governador Valadares
Três Marias Reservoir
Ituiutaba
Uberlândia
Curvelo
Paranaíba
Uberaba
Mato Grosso do Sul
Sete Lagoas
Belo Horizonte
Espírito Santo
Araxá
Linhares
Colatina
Jales
Fernandópolis
Franca
Divinópolis
Aquidauana
Campo Grande
São José do Rio Prêto
Andradina
Passos
Furnas Res.
Carangola
Manhuaçu
Vitória
Vila Velha
Bebedouro
Araçatuba
Ribeirão Prêto
Lavras
Bela Vista
Dourados
Presidente Prudente
São Paulo
Araraquara
Varginha
Barbacena
Muriaé
Cachoeiro de Itapemirim
Paraguay
Marília
Bauru
Rio Claro
Juiz de Fora
Campos
Ponta Porã
Ourinhos
Campinas
Petrópolis
Nova Friburgo
Volta Redonda
Paranavaí
PARAGUAY
Concepción
Maringá
Londrina
São Paulo
Nova Iguaçu
Rio de Janeiro
Niterói
Mogi das Cruzes
SETE QUEDAS N.P.
Umuarama
Apucarana
Sorocaba
Santo André
Rio de Janeiro
Pilcomayo
Campo Mourão
São Bernardo do Campo
Guaira
Paraná
Registro
Santos
Itaipu Res.
Cascavel
Ponta Grossa
Castro
Asunción
IGUAÇU N.P.
Guarapuava
Irati
Curitiba
Iguaçu
União da Vitória
Rio Negro
Paranaguá
Villarrica
Pato Branco
Joinvile
Pôrto União
São Miguel d'Oeste
Santa Catarina
Itajaí
Alto Paraná
Blumenau
Chapecó
Joaçaba
Brusque
Resistencia
Corrientes
Posadas
Santa Rosa
Erechim
Lajes
Florianópolis
Santo Ângelo
Ijuí
Passo Fundo
Cruz Alta
Criciúma
Tubarão
São Borja
Caxias do Sul
Uruguay
Araranguá
Rio Grande do Sul
APARADOS DA SERRA N.P.
Santa Maria
Canoas
Uruguaiana
Cachoeira do Sul
Pôrto Alegre
Paraná
Mar Chiquita
Santana do Livramento
Patos Lagoon
Bagé
Pelotas
Santa Fe
Concordia
Salto
Paraná
Melo
Rio Grande
Paysandú
Lake Rincón del Bonete
Mirim Lake
Rosario
URUGUAY
500
750
1,000
1,250
1,500
1,750
2,000 Miles
750
1,000
1,250
1,500
1,750
2,000
2,250
2,500
2,750
3,000 Kilometers

fortune-seeking Brazilians and foreigners. After World War II ended in 1945, fast-growing industries in the southeastern coastal cities attracted great numbers of Brazilians from rural areas.

The coastal cities, however, could not provide jobs for many of the newcomers. Unemployment, overcrowding, and other problems developed. As a result, the Brazilian government has tried to attract people from the crowded coastal cities to the underpopulated interior. In 1960, it moved the nation's capital from Rio de Janeiro, on the coast, to Brasília, about 600 miles (970 kilometers) inland on the central plateau. The development of agricultural and mineral resources attracted many new settlers to the Amazon Region during the mid-1900's. In the 1970's, the government began to offer free land to people who would settle in the Amazon Region.

Ancestry. Brazil has three main ethnic groups—people of African descent, people of European origins, and people of mixed ancestry. The mixed groups include *caboclos* (people of mixed European and Indian ancestry) and *mulattoes* (people of mixed African and European descent). Statistics on the ethnic composition of the population tend to be unreliable. According to the Brazilian government, people of European descent make up about 55 percent of the nation's population and those of African descent include about 6 percent. But large numbers of people are of mixed African and European ancestry. American Indians and Asians account for about 1 percent of the population.

The Tupí-Guaraní and other Indian groups lived in what is now Brazil long before Europeans arrived. The country had from 1 million to 5 million Indians when the first Portuguese came. The early Portuguese colonists tried to make the Indians work on plantations. But these efforts failed, and so Africans were brought as slaves to replace the Indians. By the early 1800's, Brazil had about 900,000 Europeans, 2 million Africans, and 1 million Indians and people of mixed ancestry.

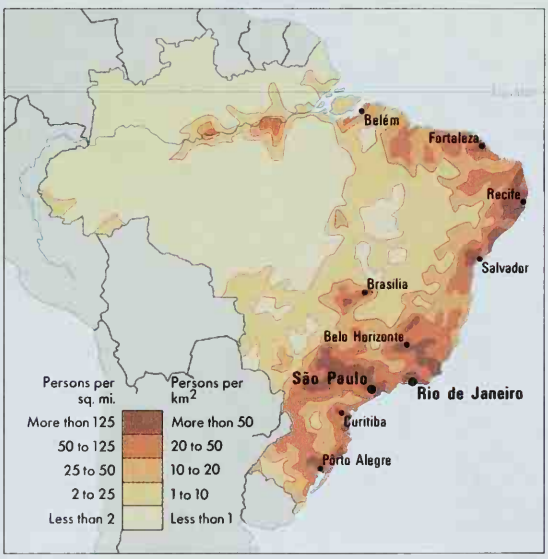
© Loren McIntyre

Indians make up less than 1 percent of Brazil's people. Most Brazilian Indians, such as the Bororos shown here, live in forests of the Amazon Region and follow traditional ways of life.

Population density

The population of Brazil is distributed unevenly. The vast majority of Brazil's people live along the Atlantic coast, but the interior of the country is thinly populated.

WORLD BOOK map



Brazil declared itself independent in 1822, and immigrants began to arrive from many European countries. The main groups included Germans, Italians, and Spaniards, as well as Portuguese. Most of the immigrants came to work in the rapidly growing coffee industry in southeastern Brazil. About half settled in what is now the state of São Paulo.

Today, most Brazilians of European descent live in the southern part of the country. Brazilians of African descent, caboclos, and mulattoes form the major groups in the coastal cities and towns north of Rio de Janeiro, particularly in the northeast. Brazil's Indian population totals approximately 200,000. Most of the Indians live in the Amazon Region.

Brazil's ethnic groups generally get along well with one another. Racial discrimination in Brazil is less widespread than in many other countries with people of several ethnic groups. But Brazilians of European descent have had better educational opportunities. As a result, they hold most of the higher jobs in government and industry. Many Brazilians of non-European descent have excelled in the arts, entertainment, and sports.

Almost all of Brazil's people speak Portuguese, the nation's official language. Indian groups in the Amazon area still use traditional languages.

Way of life

Lifestyles in Brazil's urban areas differ greatly from those in its rural areas. In the large cities, life moves at a fast pace, and a variety of modern conveniences and government services are available. Although many Brazilian city dwellers live in miserable poverty, there are a growing number of skilled, educated Brazilians who have good jobs and enjoy a decent standard of living in the cities. In the rural areas, the slow pace of life has changed little through the years. Large numbers of unskilled laborers continue to work long hours for low wages, and life remains hard. In general, the people in rich, industrialized southern Brazil have a higher standard of living than the people in the more rural northeast and the largely undeveloped Amazon forest area.

City life. Brazil's big cities look much like those in the United States and Canada. Rows of impressive skyscrapers tower above busy downtown streets, and streams of cars and trucks jam wide expressways at rush hours. Elegant stores and restaurants attract crowds of customers. Sleek, new high-rise apartment buildings stand on broad avenues and contrast sharply with old houses that line narrow, winding streets.

Large numbers of city dwellers work in banks, factories, hotels, office buildings, and stores. Many own businesses. Others hold government or professional jobs. Many middle-class city dwellers live in modern apartments. Other middle-class Brazilians live in small suburban houses. Most executives and other wealthy Brazilians live in luxurious apartments or mansions.

Like most large North American cities, Brazil's big cities face such problems as overcrowding, poverty, and slums. Rio is one of the world's most densely populated cities. Poverty is widespread in Brazil's cities. The poor include millions of unskilled and uneducated Brazilians

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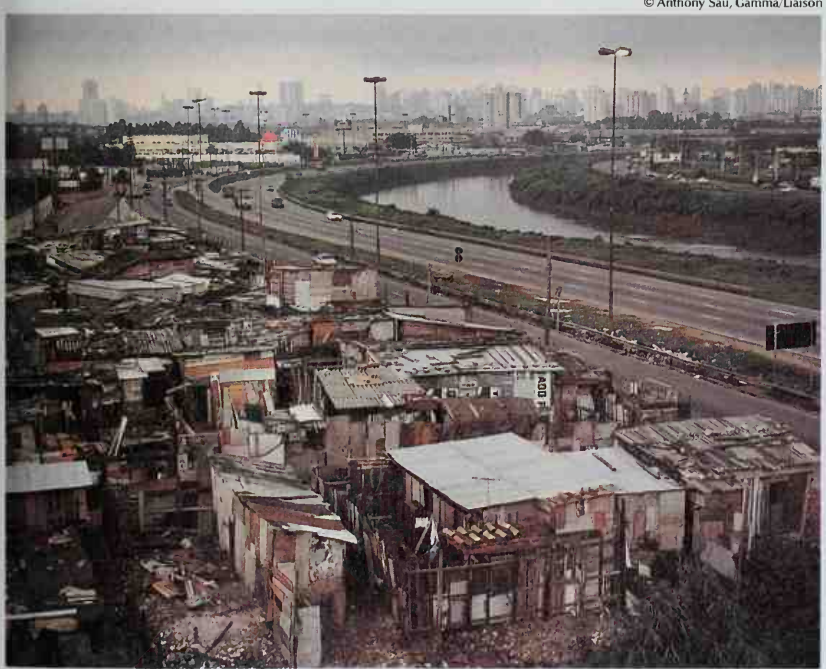
A food stand in Bahia shows the African influence in Brazilian cooking. Bean cakes and crabs, *foreground,* are often served with sauces made with African herbs and spices.

© Anthony Sau, Gamma/Liaison



A slum called a *favela* lies on the outskirts of São Paulo and contrasts sharply with the modern high-rise buildings downtown. In some Brazilian cities, as many as 30 percent of the people live in slums. Slum families crowd together in shabby shacks made of cardboard, metal, or wood. Favelas lack sewers and running water, and many people who live there suffer from disease and malnutrition.

who have moved from rural areas. Most of them earn low incomes, and many others are unemployed.

Most poor city dwellers live in slums called *favelas*. In some Brazilian cities, up to 30 percent of the people live in slums. Rio has nearly 300 favelas. Slum families crowd together in shacks made of cardboard, metal, or wood. The favelas lack sewers and running water. Many people suffer from disease and malnutrition. The crime rate is high. Many poverty-stricken parents abandon their children because they cannot feed or clothe them. Every day, millions of children in Brazilian cities must beg, steal, or work long hours to get enough money to survive. Many of these children have no homes. They sleep in doorways, on benches, or under trees.

The Brazilian government has torn down a number of favelas and replaced them with low-cost public housing. Public youth centers have taken in many abandoned children. But poverty remains a major problem.

Rural life. Most of the people who live in Brazil's rural areas work on large plantations or ranches. Some others have their own small farms. Most rural Brazilians earn little money and can barely feed their families. Malnutrition and poverty are especially widespread in the dry interior of the northeast.

Most rural families live in small one- or two-room houses made of stone or adobe with roofs of red or orange clay tiles. Some of the early colonial houses are decorated with painted tiles brought from Portugal. In the Amazon Region, most houses are made of wood or wild cane plants. They have roofs of palm leaves. Dwellings built near rivers stand on stilts to avoid flooding. Most rural houses are simply furnished. Many country people sleep in hammocks.

During the middle and late 1900's, many farmworkers moved to the cities in hope of finding well-paying factory jobs. As a result, the percentage of Brazilians living in rural areas dropped sharply.

Clothing in Brazil is similar to that worn in the United States and Canada on warm days. Some regional styles are distinctive. For example, women of African descent in the state of Bahia, in northeastern Brazil, are known for their colorful long skirts, bright blouses, and many bracelets and necklaces. The *gauchos* (cowboys) of southern Brazil wear ponchos and baggy trousers called *bombachas*. Wide-brimmed felt hats protect the gauchos' heads from the sun.

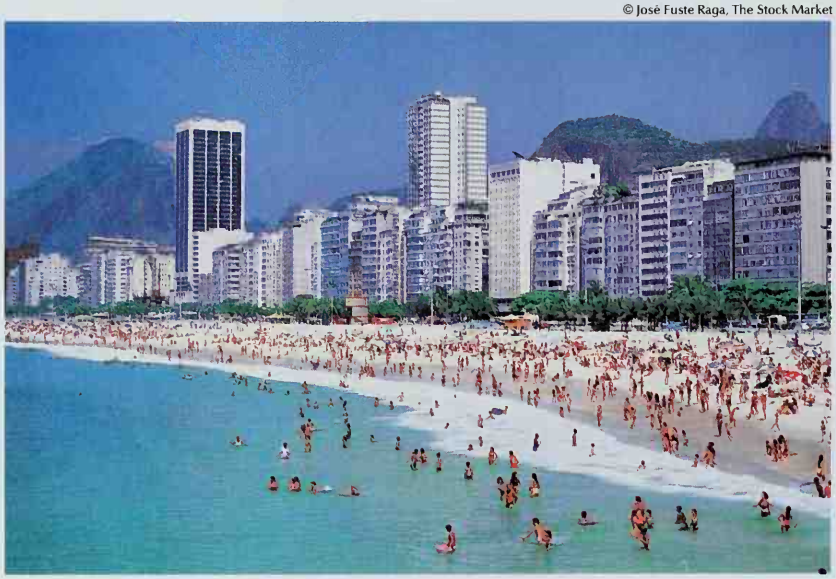
© Chris Cole, Allsport

Soccer is Brazil's favorite sport. Brazilians play the game in stadiums, in parks, and on playgrounds throughout the country.

Food and drink. Brazilians who live in cities enjoy a much wider choice of food than people in the rural areas. Cola beverages, hamburgers, and wheat bread have become increasingly popular in Brazil's larger cities. The diet of wealthy city dwellers includes a variety of meats. In the rural areas and in poor sections of the cities, the chief foods are beans, a starchy root called *cassava* or *manioc*, and rice. *Feijoada*, Brazil's national dish, combines black beans, dried beef, and pork.

Brazilian food shows a strong African influence in Bahia, where many people prepare dishes with bananas, coconuts, fish, palm oil, and hot peppers. Southern

© José Fuste Raga, The Stock Market



Copacabana Beach, one of the most famous beaches in the world, attracts crowds of visitors to Rio de Janeiro. Gleaming white beaches like Copacabana line the long Atlantic coast of Brazil.

Brazil is known for *churrasco,* a selection of charcoal-broiled meats. Coffee is Brazil's chief drink. Brazilians also like *batidas* (sweet fruit beverages made with rum), beer, and a tealike drink called *maté.*

Recreation. Thousands of people flock to Brazil's broad, white beaches on weekends. Many Brazilians enjoy fishing, skin diving, swimming, and boating.

Soccer, called *futebol* in Brazil, is the country's favorite sport. Some games attract 200,000 spectators to Rio's Maracanã Stadium, the world's largest stadium. Many Brazilian soccer stars have become national heroes. One of them, Pelé, became known as the world's greatest soccer player during the 1960's. Other popular sports include automobile racing, basketball, and horse racing.

A number of colorful festivals brighten life in Brazil. The best known is Carnival, celebrated each year during the four days before the Christian observance of Lent. In the Carnival of Rio de Janeiro, thousands of richly costumed Brazilians ride magnificent floats that compete for prizes in dazzling parades. Energetic dancers, their bodies swaying to the rhythms of the samba, crowd the streets. Joyful singers and lively musicians add to the fun.

Religion. The early Portuguese colonists brought the Roman Catholic religion to Brazil. Today, Catholics form about 70 percent of the population. Brazil has more Catholics than any other country does. However, many of them do not actively practice their religion.

Many Brazilians, mostly people of African and mixed ancestry, practice such local religions as *macumba* and *candomblé.* These religions combine African spiritual beliefs and Catholicism. Protestants make up about 20 percent of Brazil's population. Brazil also has small numbers of Buddhists and Jews.

Education. Most of Brazil's adults can read and write. But educational levels vary widely throughout the nation. In general, they are highest in southern Brazil and lowest in the northeast. For the country's literacy rate, see **Literacy** (table: Literacy rates for selected countries).

Brazil has a free public elementary school system. According to the law, children from ages 7 through 14

© Ary Diesendruck, Tony Stone Images

The colorful Carnival festival in Rio de Janeiro features costumed street dancers and lively parades. Carnival takes place each year just before the Christian observance of Lent.

© Jacques Jangoux, Peter Arnold, Inc

A church procession makes its way through the streets of the town of Ouro Prêto in the state of Minas Gerais. About 70 percent of Brazil's people are Roman Catholics. Brazil has more Catholics than any other country does.

must attend school, but the law is difficult to enforce. Many children leave school after completing the requirement and begin work. Most of these children are from poor rural families. Many rural areas of Brazil lack schools and teachers. In some of these areas, the government broadcasts instruction over the radio. University student volunteers teach in other areas. Government programs to teach adults how to read and write are widespread.

Public high schools are free. But most of Brazil's high schools are private and charge tuition. The Catholic Church operates many high schools. Brazil has about 65 colleges and universities. The largest is the University of São Paulo.

Brazil has many fine libraries, museums, and research centers. The National Library in Rio de Janeiro, the largest library in South America, has about 3 million books. The Municipal Public Library of São Paulo is known for its collection of children's books. The National Museum in Rio ranks among the best natural history museums in South America. The National Museum of Fine Arts in Rio and the São Paulo Museum of Modern Art have notable collections of Brazilian and European paintings. The Oswaldo Cruz Institute in Rio specializes in medical research. Rio also has one of the world's largest botanical gardens. At the Butantan Institute of São Paulo, lifesaving snakebite serums are prepared and sent to countries around the world.

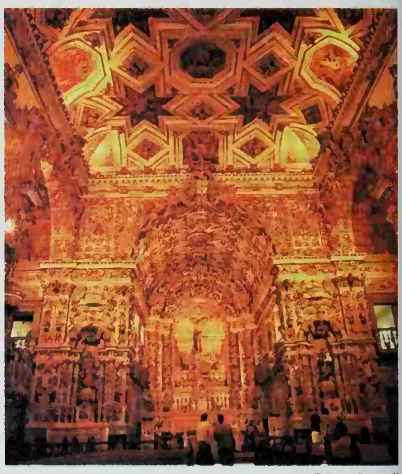
The arts

Traditional Indian handicraft items—such as baskets, pottery, and jewelry—were the earliest expressions of art in Brazil. The sculpture of Antônio Lisboa ranks among the earliest and best-known examples of Brazil's colonial art. During the late 1700's and early 1800's, he created many beautiful religious figures for churches in the state of Minas Gerais.

Brazilian literature has long been known for its revealing descriptions of the country's people. In the mid-1800's, Brazil's Indians and slaves appeared as themes in

Coffee, an oil painting on canvas (1935); Museu Nacional de Belas Artes, Rio de Janeiro

Brazilian painting often deals with the country's history and culture. In this painting, Cândido Portinari celebrates the importance of coffee in the Brazilian economy.



© Dave Bartruff

São Francisco Church in Salvador features decorative architecture of colonial times.

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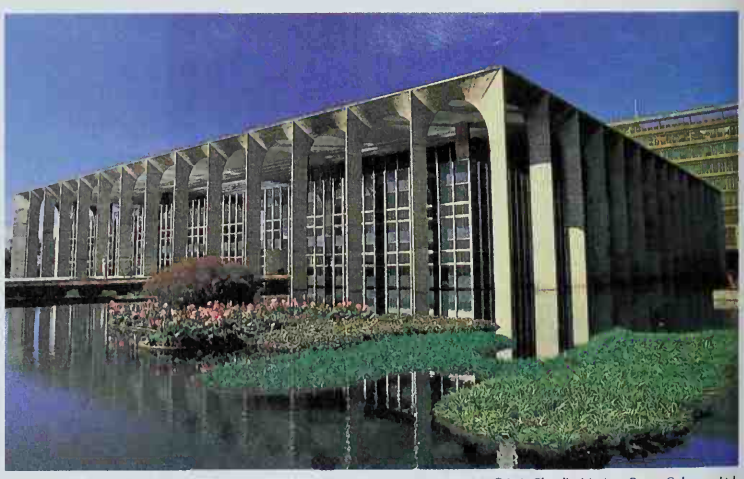
Brazilian sculpture, such as this by Antônio Lisboa, often deals with religion.



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Modern Brazilian architecture gained international fame for the designs created by Oscar Niemeyer for the capital, Brasília. The Itamaraty Palace is shown here.

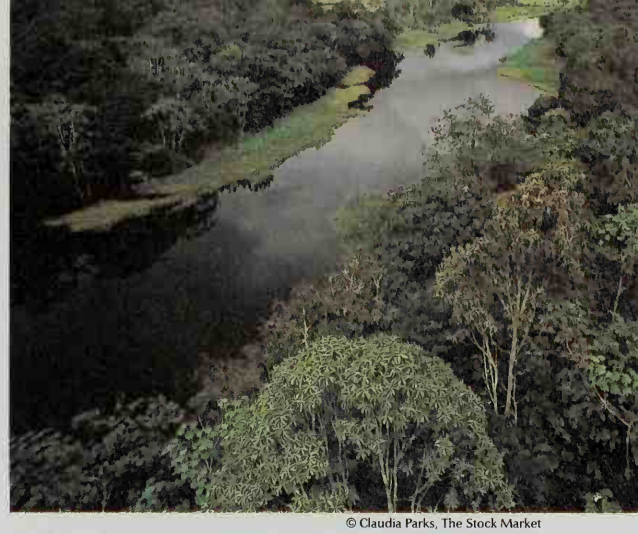
many notable works, including poems by Antônio Gonçalves Dias and Antônio de Castro Alves, and the book *O Guaraní* (1857) by José de Alencar. In the early 1900's, the novelists Joaquim Maria Machado de Assis and Euclides da Cunha won fame for realistic portrayals of Brazil's changing society. Machado de Assis's best-known novel, *Dom Casmurro* (1900), has been translated into many languages. Cunha's famous novel *Os Sertões (Rebellion in the Backlands,* 1902) describes an actual peasant rebellion of the 1890's.

After 1920, Brazilian literature began to show a strong regional influence. Famous novels dealing with the struggles of people in the northeast and Minas Gerais were *Jubiabá* (1935) by Jorge Amado and *The Devil to Pay in the Backlands* (1956) by João Guimarães Rosa.

During the 1900's, several Brazilians won fame for their distinctive styles in other arts. The architect Oscar Niemeyer designed strikingly modern public buildings for Brasília. The painter Cândido Portinari created bold murals that now hang in the United Nations General Assembly Building in New York City and in the Library of Congress in Washington, D.C. The composer Heitor Villa-Lobos beautifully combined classical and Brazilian music in his *Bachianas Brasileiras* symphony.

Popular music from Brazil won international attention during the 1900's. Antônio Carlos Jobim and João Gilberto composed songs in the style of lilting Brazilian dance music called *bossa nova.* Sergio Mendes also wrote many tunes based on the bossa nova style. The composers and singers Gilberto Gil and Caetano Veloso became known for a style of music called *tropicalism,* the lyrics of which dealt with social issues. Milton Nascimento composed and sang songs in a style that blended aspects of traditional Brazilian folk music with elements of jazz, rock, bossa nova, and classical music.

Brazilian motion pictures and plays also have gained world attention. The work of filmmakers Carlos Diegues, Nelson Pereira dos Santos, and Glauber Rocha and playwrights Dias Gomes and Nelson Rodrigues have won particular acclaim.



© Claudia Parks, The Stock Market

The Amazon River flows through the Amazon Region in northern Brazil. This region occupies over half the country and consists chiefly of lowlands covered by tropical rain forests.

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The sertão forms the interior of Brazil's Northeast Region, which bulges into the Atlantic Ocean. The sertão has poor soil for farming and often suffers from severe droughts.

Land and climate

Brazil is one of the largest countries in the world in area. It covers nearly half of South America. Low mountains and broad plateaus occupy two-thirds of the country. Forested lowlands cover most of the rest. Brazil has over 1,000 rivers. The largest include the Amazon, Paraná, and São Francisco.

All but the southernmost part of Brazil lies in the tropics, and most of the country has a warm to hot climate the year around. The mountains and plateaus are cooler than the lowlands. Sea breezes cool some coastal areas. Rain falls heavily in much of Brazil, and the country's warm, wet climate has helped make it one of the leading crop-growing nations in the world.

Brazil has three main land regions: (1) the Amazon Region, (2) the Northeast Region, and (3) the Central and Southern Plateaus.

The Amazon Region extends across most of northern Brazil. It occupies over half the country and consists chiefly of lowlands covered by jungle and tropical rain forest called *selva.* The region has two mountain areas, the Guiana Highlands in the far north and the Brazilian Highlands in the south. Pico da Neblina, Brazil's highest mountain, rises 9,888 feet (3,014 meters) near the Brazilian-Venezuelan border.

Manaus, the largest city in the central Amazon, has an average annual temperature of 81 °F (27 °C). Rain falls throughout the year in the Amazon Region and is especially heavy from December to May. The western part of the region is always hot and humid. It gets more than 160 inches (400 centimeters) of rain a year. The eastern part averages from 40 to 80 inches (100 to 200 centimeters). The Amazon Region is little developed and thinly populated because of a lack of resources. Only approximately 7 percent of Brazil's people live there. The region's name comes from the Amazon River, which has its source in Peru. The muddy-brown Amazon flows 1,962 miles (3,158 kilometers) through Brazil's rain forests. It empties into the Atlantic Ocean. The Amazon is the world's second longest river. Only the Nile is longer. Oceangoing ships can travel the Amazon's entire length within Brazil.

Physical features

Amazon Region ..... C 3
Amazon River ..... B 4
Araguaia River ..... C 5
Aripuanã River ..... C 3
Branco River ..... A 3
Brazilian Highlands ..... D 6
Cape São Roque ..... C 7
Central and Southern Plateaus ..... E 4
Grande River ..... E 5
Guaporé River ..... D 3
Guiana Highlands ..... A 3
Iguaçu Falls ..... F 4
Japurá River ..... B 2
Jari River ..... A 4
Jequitinhonha River ..... E 6
Juruá River ..... C 1
Juruena River ..... D 3
Madeira River ..... C 3
Marajó Island ..... B 5
Mato Grosso Plateau ..... D 4
Mirim Lake ..... G 4
Negro River ..... B 2
Northeast Region ..... C 6
Pantanal ..... E 3
Pará River ..... B 5
Paraguay River ..... E 3
Paraná River ..... G 3
Paranaíba River ..... E 5
Parnaíba River ..... C 6
Patos Lagoon ..... G 4
Paulo Afonso Falls ..... C 7
Pico da Bandeira (mountain) ..... E 6
Pico da Neblina (mountain) ..... A 2
Purus River ..... C 2
Rocas Atol ..... B 7
São Francisco River ..... D 6
Selva (forest) ..... B 3
Serra do Espinhaço (mountains) ..... E 6
Serra do Mar ..... F 5
Serra dos Parecis (mountains) ..... D 3
Serra do Roncador (mountains) ..... D 4
Sertão ..... C 6
Tapajós River ..... B 4
Taquari River ..... E 4
Teles Pires River ..... C 4
Tietê River ..... E 5
Tocantins River ..... C 5
Trombetas River ..... A 4
Uruguay River ..... G 4
Xingu River ..... C 4

Brazil's rain forests have more than 40,000 varieties of plants. More species of trees grow in these forests than in any other area in the world. Scientists have found more than 3,000 kinds of trees in 1 square mile (2.6 square kilometers). These trees include the giant Brazil-nut tree, which grows 150 feet (46 meters) tall. Other trees include cannon-ball, cedrela, cordia, kapok, mahogany, purpleheart, rosewood, and rubber trees. The forests yield drugs, fruits, latex, nuts, and timber.

The Amazon Region also has a great variety of animals. More than 1,500 kinds of birds live in the forests. They include parakeets, parrots, toucans, and other beautiful, rainbow-colored birds that sing and squawk from the high branches. Many kinds of screeching, howling monkeys jump from tree to tree and add to the chorus. Anacondas up to 30 feet (9 meters) long, wide-jawed boa constrictors, and other snakes dwell in the branches and near the rivers. Ants, beetles, butterflies,

© Loren McIntyre

The Iguaçu Falls, which forms part of the border between Brazil and Argentina, is about 2 miles (3 kilometers) wide. The waterfall plunges 237 feet (72 meters).

Average monthly weather

Rio de Janeiro	Temperatures °F High	°F Low	°C High	°C Low	Days of rain
Jan.	84	73	29	23	14
Feb.	85	73	29	23	12
Mar.	83	72	28	22	12
Apr.	80	69	27	21	11
May	77	66	25	19	10
June	76	64	24	18	8
July	75	63	24	17	7
Aug.	76	64	24	18	8
Sept.	75	65	24	18	12
Oct.	77	66	25	19	14
Nov.	79	68	26	20	14
Dec.	82	71	28	22	15

Manaus	Temperatures °F High	°F Low	°C High	°C Low	Days of rain
Jan.	88	75	31	24	19
Feb.	88	75	31	24	18
Mar.	88	75	31	24	17
Apr.	87	75	31	24	19
May	88	75	31	24	17
June	88	75	31	24	10
July	89	74	32	23	8
Aug.	91	75	33	24	6
Sept.	92	75	33	24	6
Oct.	92	76	33	24	11
Nov.	91	76	33	24	12
Dec.	90	75	32	24	>

mosquitoes, and other insects live throughout the region. Other Amazon animals include anteaters, jaguars, sloths, tapirs, *caymans* (alligatorlike reptiles), and *capybaras.* Capybaras are the world's largest rodents and may weigh as much as 100 pounds (45 kilograms).

The Northeast Region consists of the part of Brazil that bulges into the Atlantic Ocean. It extends south from the state of Maranhão through Bahia. The region occupies less than a fifth of Brazil's area. About 30 percent of the nation's people live there.

The Northeast has two subregions—the *coastal plain* and the *sertão,* or interior backlands. The coastal plain lies along the Atlantic and has large areas of fertile red soil. Farmers there grow cacao beans, sugar cane, and tobacco. Several big cities stand along the coast. They include Fortaleza, Recife, and Salvador.

The sertão consists of thinly populated plateaus and hilly portions of the Brazilian Highlands. Farmers in the sertão mainly raise cattle. They also grow beans, cassa-

Average yearly precipitation

Rainfall in Brazil is heaviest in the Amazon Region. The driest area of the country is the Northeast. The rest of Brazil receives moderate annual rainfall.

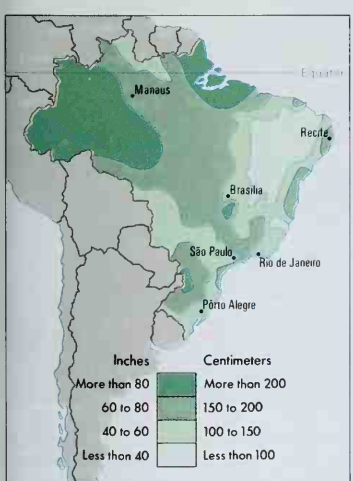
Average January temperatures

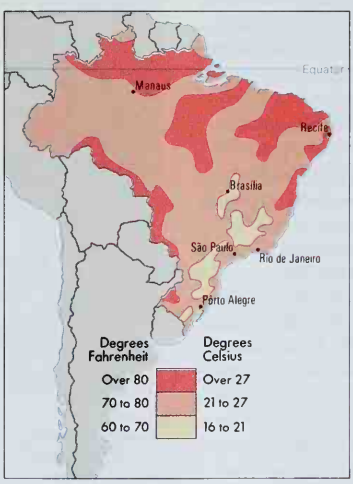
January is Brazil's hottest month of the year. The average temperature in most of the country that month ranges from about 70 to 80 °F (21 to 27 °C).

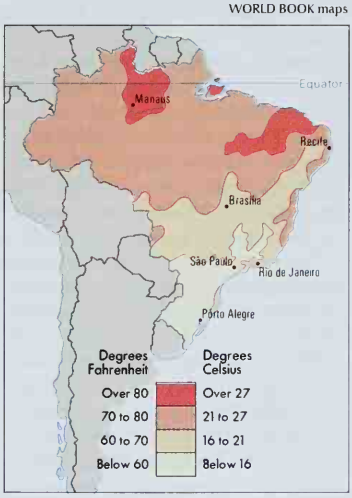
Average July temperatures

Winter temperatures in Brazil vary only slightly from those of summer because all but the southernmost part of the country lies in the tropics.

WORLD BOOK maps







va, corn, and cotton. But good grazing lands are scarce, and most of the soil is poor. As a result, agricultural production is generally low. Two main rivers cross the interior, the Parnaíba and the São Francisco.

The Northeast Region has a wide range of temperatures. Temperatures in the interior vary from 53 to 107 °F (12 to 42 °C) during the year. But in Recife, on the coast, the temperature remains much the same throughout the year, averaging about 80 °F (27 °C).

Annual rainfall in the Northeast varies from about 65 inches (169 centimeters) in some coastal areas to only about 10 inches (26 centimeters) in parts of the interior. Almost all the rain in the interior falls from December to April. Heavy rains often cause rivers to flood farmland. The interior also suffers from frequent droughts. Some severe droughts have lasted up to two years and have made the area as dry as a desert.

Most *nordestinos,* as the people of the Northeast are called, have a hard life. In the interior, many nordestinos live in small clay houses with dirt floors. Because of the droughts, floods, and poor soil, they must struggle to make a living from farming. Much of the land is used mainly for *subsistence agriculture*—that is, for growing food crops only for the family's own use. Life is also harsh in the Northeast's cities. There are few large industries, and unemployment is high. Millions of people suffer from malnutrition and sickness. Life expectancy at birth in the Northeast is only 49 years, well below the national average.

The Central and Southern Plateaus lie south of the Amazon and Northeast regions. This area covers about a fourth of Brazil and includes most of the Brazilian Highlands. The highlands rise between 1,000 and 3,000 feet (300 and 900 meters). The highest elevations are near the coast. A steep slope known as the *Serra do Mar* runs along the coast on the southeastern edge of the highlands. It has prevented easy access to the interior and promoted the growth of coastal cities.

More than half of Brazil's people live in the plateau region. Much of the population is concentrated in and around São Paulo and Rio de Janeiro. The region, known as Brazil's economic heartland, also has the country's most fertile farms, finest cattle ranches, and some of its richest mines. Farmers in the plateau region grow coffee—one of Brazil's top farm exports—on large plantations called *fazendas.* Farmers also grow cotton, grapes, potatoes, rice, soybeans, sugar cane, and wheat. The region has large deposits of gold, iron ore, manganese, and other minerals.

The Paraná River is the chief river in the plateau region. Brazil's biggest hydroelectric power project, the Itaipú Dam plant, lies on the Paraná. Nearby, on the Iguaçu River at the border between Brazil and Argentina, the majestic Iguaçu Falls drops 237 feet (72 meters).

The plateau region has a cooler climate than the Amazon Region and the Northeast. Daily temperatures in São Paulo average about 73 °F (23 °C) in January and about 60 °F (16 °C) in July. Winter frosts often occur in the state of Paraná, and light snow sometimes falls in the state of Santa Catarina. Rainfall averages about 50 inches (130 centimeters) a year in the plateau region. The rainy season lasts from November to May.

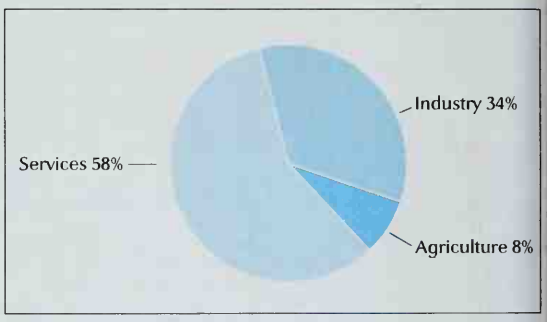
Along the Paraguay River, where Brazil borders Bolivia and Paraguay, lies a vast swampy area called the Pantanal. Only a few people, mostly cattle ranchers, inhabit the Pantanal. The area has huge flocks of water birds and many other animals. Large numbers of tourists visit the Pantanal to view its wildlife.

Economy

Brazil's farms, forests, and mines have long produced an enormous amount of valuable exports. But today, factories and service industries contribute the most to Brazil's *gross domestic product* (GDP). The GDP is the total value of all goods and services produced within a country in a year. Brazil's GDP is the highest in Latin America and one of the highest in the world.

Brazil's economy is based on private enterprise. But the government controls the steel industry and some other basic industries. Heavy foreign investment in industry during and after World War II (1939-1945) helped bring about a huge increase in manufacturing. Brazil doubled its economic output during the 1960's and 1970's. However, Brazil also faces major economic problems, including widespread poverty and unemployment.

Brazil's gross domestic product



Brazil's gross domestic product (GDP) was $529,398,000,000 in 1999. The GDP is the total value of goods and services produced within a country in a year. *Services* include community, government, and personal services; finance, insurance, real estate, and business services; transportation and communication; and wholesale and retail trade. *Industry* includes construction, manufacturing, mining, and utilities. *Agriculture* includes agriculture, forestry, and fishing.

Production and workers by economic activities

Economic activities	Percent of GDP produced	Employed workers: Number of people	Employed workers: Percent of total
Community, government, & personal services	26*	26,721,300	37
Manufacturing	20	8,278,100	12
Finance, insurance, real estate, & business services	20	1,344,300	2
Construction	9	4,743,100	7
Agriculture, forestry, & fishing	8	17,372,100	24
Wholesale & retail trade	7	9,618,400*	13*
Transportation & communication	5	2,815,200	4
Utilities	3	†	†
Mining	2	783,100	1
Total	100	71,675,600	100

*Includes figures from restaurants and hotels.
†Included in Mining figure.
Figures are for 1999.
Sources: International Labour Organization; International Monetary Fund.

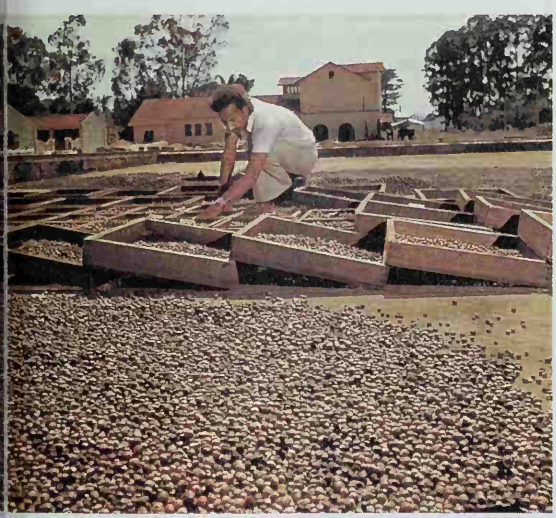
Service industries employ about three-fifths of Brazil's workers. The most important group of service industries consists of community, government, and personal services. This group of services includes education, health care, and many other activities. Community, government, and personal services employ about a third of Brazil's workers. Other types of service industries are finance, insurance, real estate, and business services; transportation, communication, and utilities; and wholesale and retail trade.

Manufacturing accounts for about a fifth of Brazil's gross domestic product. Factories employ about 12 percent of the nation's workers. The state of São Paulo is Brazil's chief industrial region.

Brazil is one of the leading industrial nations of the world. The nation ranks among the world's major automobile producers. Latin America's largest iron and steel plant is at Volta Redonda, near Rio. Brazil is one of the world's top producers of raw sugar and textiles. It is also a leading publishing center of South America. Other chief Brazilian industries make airplanes, cement, chemicals, electrical equipment, food products, machinery, paper, pharmaceuticals, and transportation equipment.

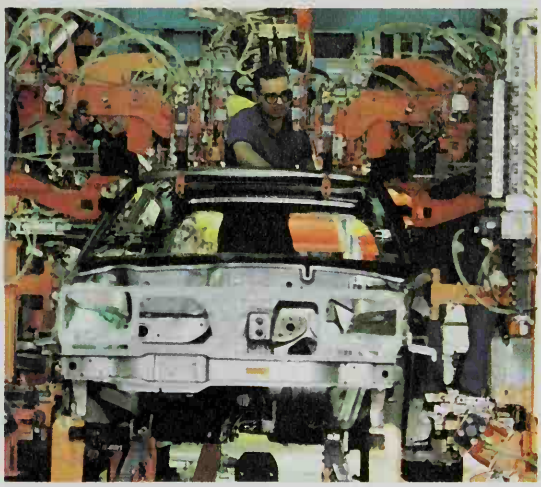
Agriculture accounts for 8 percent of Brazil's economic output. Brazil is a world leader in the production of crops and livestock, and only the United States exports more farm products. About a fourth of Brazil's workers are employed in agriculture. Most of them work on big farms and ranches owned by corporations and wealthy Brazilians.

Brazil grows about a fifth of the world's coffee crop. Brazil also leads all nations in growing oranges, papayas, and sugar cane. It is one of the world's top producers of bananas, cacao beans, cashews, cassava, corn, cotton, lemons, pineapples, rice, soybeans, and tobacco. Brazil is a world leader in raising cattle, chickens, hogs, horses, and sheep. In addition, it is Latin America's top producer of meat, milk, and eggs. Brazil's chief farming and grazing areas are in the south.



© Agence Hoa-Qui

Coffee is one of Brazil's most valuable exports. The country produces about a fifth of the world's coffee crop. Coffee is made from the dried beans, *shown here,* of the coffee plant.



© Marcelo Soubhia, Latin Focus

Automobile manufacturing is a major industrial activity in Brazil, one of the world's leading car producers. This factory in São Paulo has helped make the city a great industrial center.

Mining. Brazil is rich in minerals. It is the world's main source of high-quality quartz crystals. It ranks among the world's top producers of amethysts, asbestos, bauxite, beryllium, diamonds, gold, graphite, iron ore, magnesium, manganese, mica, and tin. Brazilian mines also yield agates, barite, chrome, clays, coal, copper, gypsum, lead, lime, nickel, phosphates, talc, topaz, tungsten, uranium, and zinc. Wells along the coast produce petroleum and natural gas. Brazil has one of the largest reserves of iron ore in the world. Most of the country's iron ore and other minerals come from the state of Minas Gerais. Brazil's Amazon Region also has vast mineral deposits.

Forestry. Brazil ranks as one of the world's leading producers of forest products. The country's chief forest product is timber from an *araucaria* tree called the Paraná pine, which grows in southern Brazil. Much timber is made into charcoal, an important source of fuel in rural areas of Brazil and in the country's iron and steel industry. Besides timber, the forests of Brazil yield carnauba wax, fibers, gums and resins, medicines, nuts, oils, and rubber.

Fishing. Brazilians fish along the Atlantic coast and in the rivers of the Amazon Basin. Croakers, sardinellas, shrimp, and lobsters are caught in the ocean. The rivers yield tropical fish, such as characins.

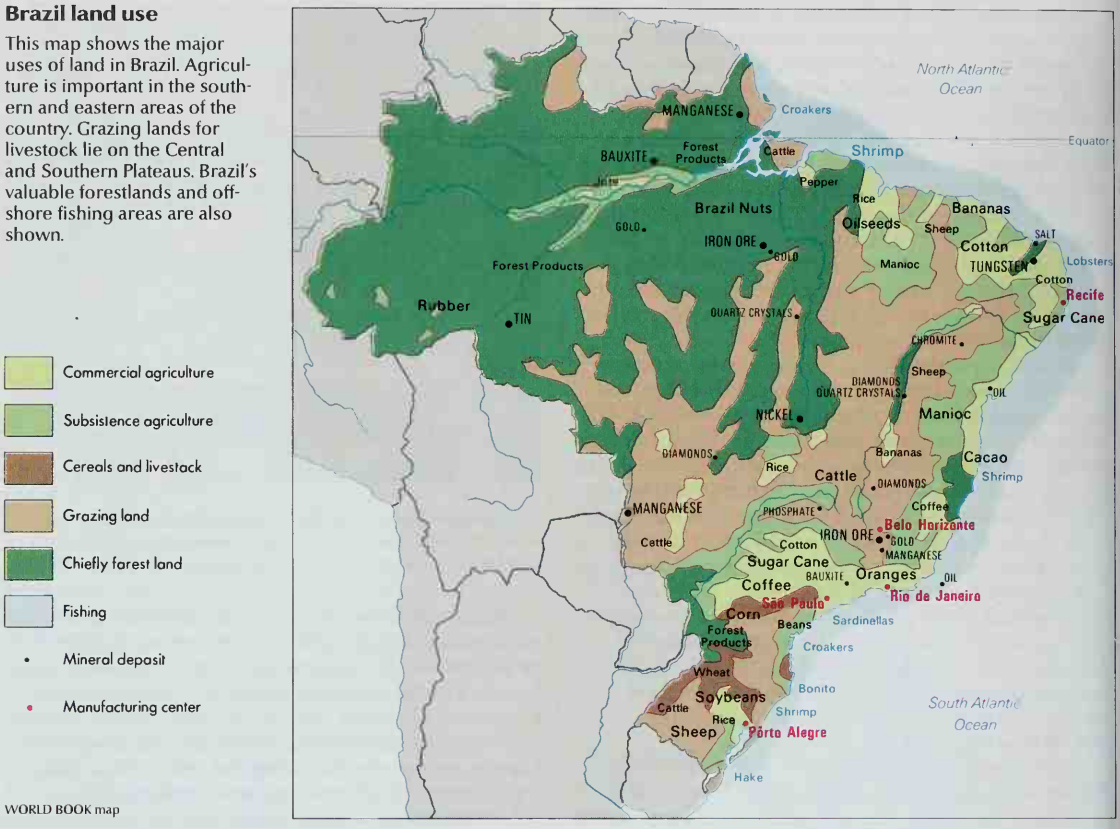
Energy sources. Hydroelectric power stations produce nearly all of Brazil's electric power. Large power plants operate on the Paraná, São Francisco, Tocantins, and other rivers. The Itaipú Dam power plant on the Paraná River is one of the most powerful hydroelectric plants in the world. The plant, which was built by Brazil and Paraguay, has a generating capacity of about 12 $\frac{1}{2}$ million kilowatts.

Brazil produces about 50 percent of the oil it needs each year. It buys most of the rest from the Middle East. Coal and charcoal provide some energy in Brazil.

In the mid-1970's, the high cost of imported oil led Brazil to develop a program that substitutes *ethanol,* a type of alcohol, for fuels made from petroleum. Under

Brazil land use

This map shows the major uses of land in Brazil. Agriculture is important in the southern and eastern areas of the country. Grazing lands for livestock lie on the Central and Southern Plateaus. Brazil's valuable forestlands and offshore fishing areas are also shown.



WORLD BOOK map

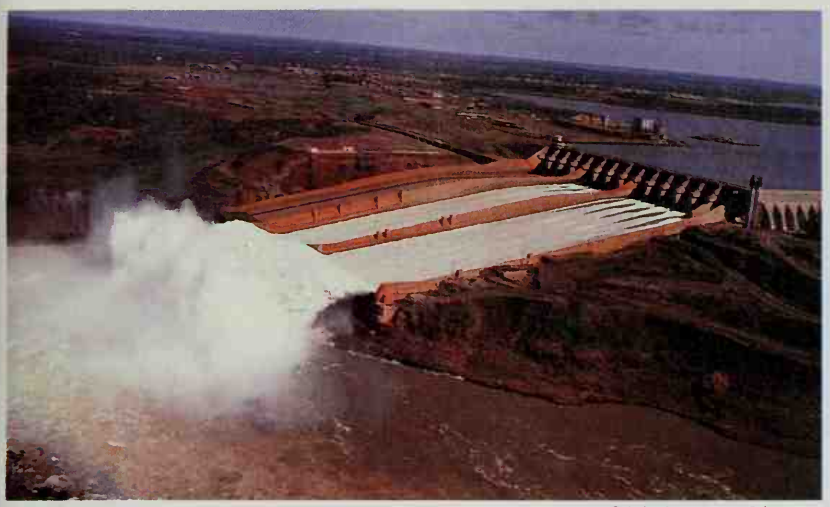
this program, Brazilian farmers "grow" fuel—that is, they raise sugar cane that distilleries make into ethanol fuel. Brazil leads all countries in the production of ethanol and in the manufacture of ethanol-fueled cars. Most new automobiles made in Brazil run entirely on ethanol.

International trade. Coffee, iron ore, and soybeans and soy meal rank as Brazil's most valuable exports. Other major exports include aluminum, iron and steel, meat, oranges and orange juice, shoes, sugar, and transportation vehicles and parts. Petroleum ranks as Brazil's main import. Other leading imports include chemicals, fertilizer, machinery, and wheat.

The United States is Brazil's chief trading partner. Brazil belongs to a trade organization known as Mercosur or Mercosul and engages in much trade with the group's other members and associate members—Argentina, Bolivia, Chile, Paraguay, and Uruguay. Brazil's other important trading partners include Canada,

© Claus C. Meyer, Black Star

An open-pit iron mine spreads across a huge area in the state of Minas Gerais. Brazil has the largest iron ore deposits in the world and ranks among the leading nations in the production of this mineral.



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The Itaipú Dam power plant, on the Paraná River, has a generating capacity of about 12 $\frac{1}{2}$ million kilowatts. It is one of the world's most powerful hydroelectric plants.

France, Germany, Italy, Japan, Mexico, the Netherlands, Saudi Arabia, and the United Kingdom.

Transportation. Brazil has a good road network in the Central and Southern Plateaus. Since the 1970's, the federal government has built a few roads to link the Amazon Region with the Atlantic coast and the south. Many stretches of these roads are still unpaved. Brazil has an average of about 1 automobile for every 10 people. Most Brazilians travel by bus. In remote areas, some people travel on horseback. Brazil's main railroad connects Rio de Janeiro and São Paulo, the country's largest seaports. Rivers serve as the chief transportation routes in the Amazon Region.

Brazil leads Latin America in commercial aviation. The largest Brazilian airline, Varig, flies to five continents, as well as within Brazil. The São Paulo area has three airports, and the Rio area has two. More than 90 cities have regularly scheduled passenger flights.

Communication. Brazil is a major producer of television programs. More than 300 daily newspapers are published in Brazil. Most are privately owned, and they represent a variety of political opinions. The best-known newspapers include *Fôlha de São Paulo, Jornal da Tarde,* and *O Estado de São Paulo* of São Paulo, and *O Globo* and *Jornal do Brasil* of Rio de Janeiro.

History

Early days. Indians lived in what is now Brazil long before the first Europeans arrived. Major Indian groups in the country included the Guaraní and Tupinamba. The Indians hunted and fished for much of their food. They also gathered fruits from the forests and grew crops. Cassava was their most important crop.

Some Indian groups lived in villages of from two to six long, thatched houses. Each family had its own section in one house. The Brazilian Indians believed in many gods and celebrated numerous religious festivals. They made baskets, pottery, and other handicraft items.

Portuguese rule. In 1494, the Treaty of Tordesillas divided the Americas between Spain and Portugal. Portugal gained the right to claim land in what is now eastern Brazil. Portugal claimed possession of Brazil on April 22, 1500, when the Portuguese fleet commander Pedro Álvares Cabral landed on the coast. The Portuguese called certain trees that they found there *brazilwoods* because their wood had the color of a glowing ember, called *brasa* in Portuguese. They named the country after the trees.

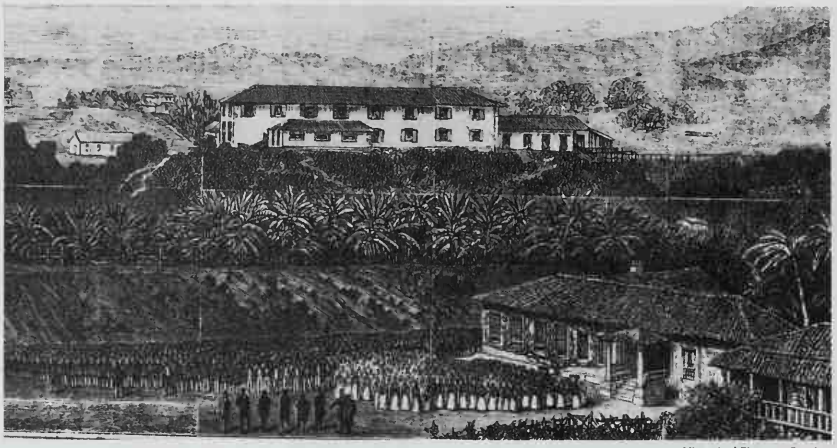
Portuguese colonists began to settle Brazil during the 1530's. The most successful early settlements developed at Recife and Salvador in the northeast and at São Vicente in southern Brazil. The colonists in the northeast soon established large sugar cane plantations. Brazilian sugar, sold in Europe, brought wealth to Portugal. Cattle hides, cotton, and tobacco also were exported.

The colonists enslaved local Indians to work on the plantations. Large numbers of Indians died from European diseases. Many others fought the Portuguese and were killed. To replace the Indians, Portugal began to bring thousands of Africans to Brazil as slaves.

In 1630, Dutch settlers seized control of the Portuguese land in northeastern Brazil. The Portuguese drove the Dutch out of Brazil in 1654. In the 1690's and

Important dates in Brazil

1500 The Portuguese fleet commander Pedro Álvares Cabral landed in Brazil and claimed it for his country.
1630 The Dutch invaded Brazil. The Portuguese drove them out in 1654.
1750 Portugal and Spain signed a treaty fixing areas of rule in South America.
1808-1821 The Portuguese royal family ruled Portugal and Brazil from Rio de Janeiro.
1822 Brazil declared its independence from Portugal.
1888 Slavery was abolished in Brazil.
1889 Brazil proclaimed itself a republic.
1917 Brazil declared war on Germany in World War I.
1930 Military officials made Getúlio Vargas president.
1942 Brazil declared war on the Axis in World War II.
1945 Brazil joined the United Nations.
1946 A new constitution restored individual rights.
1960 Brazil moved its capital from Rio de Janeiro to the newly built city of Brasília.
1964 Military leaders took control of the government.
1985 Brazil's government was returned to civilian rule.



Historical Pictures Service

A typical plantation in Brazil in the 1800's included a large number of African slaves. Most of the slaves harvested sugar cane and other crops. Others worked as servants in the house of the plantation owner.

early 1700's, adventurers from São Paulo discovered diamonds and gold in what are now the states of Minas Gerais and Mato Grosso. These discoveries attracted thousands of Portuguese to the interior and further enriched Portugal.

During the early 1700's, fortune seekers and settlers moved westward into land that the Treaty of Tordesillas had identified as Spanish territory. In 1750, Portugal and Spain signed the Treaty of Madrid, which recognized Portugal's claim to almost all of what is now Brazil. During the mid-1700's, Rio de Janeiro became a major seaport. Miners sent loads of diamonds and gold to Rio, and ships there took the treasure to Portugal. In 1763, the capital of Brazil was moved from Salvador to Rio de Janeiro. By about 1800, more than 3 $\frac{1}{2}$ million colonists and slaves lived in Brazil. The slaves made up more than half the population. Most of the colonists lived in small farming settlements. Rio, with a population of about 100,000, was the largest town.

Portugal profited tremendously from Brazil's farm products and mineral wealth. It limited the country's economic growth, however, by discouraging the development of manufacturing. Portugal wanted Brazilians to buy Portuguese manufactured goods, rather than to make these products themselves.

Independence. In 1807, France invaded Portugal because the Portuguese had supported Britain in a war between the French and British. Prince John, Portugal's ruler, fled to Rio de Janeiro with his family. In 1808, Rio became capital of the Portuguese Empire. In 1815, the prince raised Brazil to the status of a kingdom. The royal family returned to Portugal in 1821. John left his son Pedro to rule Brazil.

On Sept. 7, 1822, Pedro declared Brazil independent. A few months later, he was crowned emperor as Pedro I. He granted Brazil a constitution in 1824. But Pedro ruled harshly and became unpopular. In 1828, Brazil lost a war against Argentina and gave up the territory that is now the nation of Uruguay. In 1831, Pedro was forced to resign. He left his throne to his 5-year-old son, Pedro II.

The reign of Pedro II. In 1840, when he was 14 years old, Pedro II was declared old enough to rule on his own, and he began to head the government. Pedro II helped bring about a period of great progress. New railroads connected coastal cities and inland areas, and new telegraph lines improved communications. A modern banking system developed, and a textile industry grew. In addition, many new schools opened, including schools for agriculture and mining.

During the mid-1800's, thousands of immigrants from Germany, Italy, and other European nations started to settle in southern Brazil. Coffee growing spread rapidly in this region. A great worldwide demand for rubber products led to the development of the Amazon Region's vast natural rubber resources.

In the War of the Triple Alliance (1865-1870), Brazil joined Argentina and Uruguay in defeating Paraguay.

WORLD BOOK map

Brazil's territorial growth. Portugal gradually expanded colonial Brazil beyond the 1494 Line of Demarcation that divided the Americas between Spain and Portugal. Portuguese settlers moved into the interior during the 1600's and 1700's and drove Dutch settlers from the northeast coast in 1654. In 1750, Spain recognized Portugal's claim to nearly all of what is now Brazil. Other areas were acquired by Brazil in later treaties.

Independence or Death, an oil painting by Pedro Américo (1888); Museu Paulista da Universidade de São Paulo

Brazil's independence from Portugal was declared by Pedro I, *left center,* on Sept. 7, 1822. Pedro, the son of King John of Portugal, achieved Brazil's freedom without bloodshed. Portugal officially recognized Brazil's independence in 1825.

The war resulted in the establishment of Brazil's present boundary with Paraguay. See **Paraguay** (History).

In 1888, a law abolished slavery in Brazil and freed about 750,000 slaves. Most of them had worked on plantations, and Brazil's powerful slaveowners became angry at Pedro when they were not paid for their slaves. In 1889, Brazilian military officers supported by the plantation owners forced Pedro to give up his throne. He died in Paris two years later. In 1922, his body was brought back to Brazil. Brazilians still honor Pedro II as a national hero.

Birth of the republic. Brazil became a republic on Nov. 15, 1889. In 1891, the people adopted a constitution modeled after the Constitution of the United States. General Manoel Deodoro da Fonseca won election as Brazil's first president. He and some of Brazil's other early presidents ruled as dictators. The presidency soon began to alternate between political leaders from São Paulo and Minas Gerais, the two most powerful states.

During the early 1900's, new rubber supplies from Asia ended the great demand for Brazilian rubber. But coffee grew in importance and brought great wealth to Brazil. World War I (1914-1918) led to major industrial expansion in the nation. Many of Brazil's trading partners fought in the war and could no longer supply industrial goods to Brazil. As a result, Brazilian factories started to make many of these products and sell them in both domestic and foreign markets. In 1917, Brazil joined the Allies in the war. Brazilian ships watched for German vessels in the South Atlantic Ocean.

After the war ended, foreign demand for Brazil's products dropped sharply. Brazilian cities suffered high unemployment and labor unrest during the 1920's. At the same time, the price of coffee fell, and thousands of plantation workers lost jobs.

Political unrest also increased. The practice of alternating presidents from São Paulo and Minas Gerais led to a crisis in the election of 1930. The retiring president, Washington Luís Pereira da Sousa, favored an associate from São Paulo, Júlio Prestes, as his successor instead of a candidate from Minas Gerais. Prestes won the election. But a group of military officers supported by political leaders from Minas Gerais, Rio Grande do Sul, and other smaller states overthrew the republic. They gave the presidency to Getúlio Vargas, governor of Rio Grande do Sul.

The Vargas dictatorship. In 1934, Vargas wrote a new constitution that helped make him a national hero. The Constitution increased wages, shortened work hours, and gave labor unions many powers. It also gave the right to vote to all citizens over the age of 18 who could read and write. This provision allowed Brazilian women to vote for the first time.

Like most other nations, Brazil suffered a major economic slump during the Great Depression of the 1930's. Vargas gradually became convinced that he lacked the authority to deal effectively with Brazil's economic problems. In 1937, he prepared a new constitution that permitted him to rule Brazil as a dictator. Then he censored the press, banned political parties, and took over Brazil's labor unions. Brazilians lost most of their constitutional freedoms. Vargas created a variety of public works projects to give jobs to the unemployed. His government built many airports, highways, hydroelectric power plants, and schools. It also developed a national radio network and built the Volta Redonda steel plant.

World War II (1939-1945) brought another great surge in demand for Brazilian industrial goods. Brazil declared war on Germany and the other Axis powers in 1942. About 25,000 Brazilian troops fought on the side of Allied forces in Italy.

Return to constitutional government. In October 1945, military leaders forced Vargas to resign as head of the government. Eurico Gaspar Dutra, an army officer, was elected president. In 1946, a new constitution restored individual rights and gave an elected legislature the authority to make the nation's laws.

Vargas was elected president again in 1950. His government faced tough economic problems, including severe inflation. Brazil's economy improved little under Vargas. In 1954, the armed forces demanded his resignation. He killed himself and was succeeded by his vice president, João Café Filho.

In 1955, Juscelino Kubitschek was elected president. He built a new capital, Brasília, a day's drive from the Atlantic coast. He hoped that the new city would help develop Brazil's interior. The government moved from Rio de Janeiro to Brasília in 1960.

Manufacturing in Brazil began to thrive in the mid-1950's. Big foreign investments helped bring about rapid growth in the automobile, chemical, and steel industries. During the 1960's, millions of Brazilians moved from rural areas to urban centers to seek jobs in the new factories. As a result, São Paulo became the major industrial center of South America.

Political tension increased in Brazil after Jânio Quadros was elected president in 1960. Quadros believed Brazil should trade with all nations, and he worked to increase trade between Brazil and Communist countries. But the Brazilian legislature opposed many of his economic plans. About seven months after taking office, Quadros resigned. Vice President João Goulart succeeded him. Brazilian military leaders feared that Goulart's economic policies would open the way for a Communist take-over of Brazil. In 1964, troops led by General Humberto Castelo Branco forced Goulart from office. The general became head of the government.

Under military rule. Military officers gave Castelo Branco many powers, including authority to suspend the rights of citizens. The Brazilian people elected a Congress, but the military controlled the elections.

Brazil's economy flourished during the late 1960's. The opening of new factories in the cities continued to attract rural farmworkers. By 1970, for the first time, more Brazilians lived in urban areas than in rural areas.

In 1974, General Ernesto Geisel became president. Geisel faced congressional opposition to military government. In 1977, he proposed legislation to reform the court system. But opponents in Congress blocked the legislation. Geisel temporarily closed Congress, arrested some of his chief critics in the legislature, and barred others from politics. In 1979, General João Baptista Figueiredo succeeded Geisel. High inflation rates and labor unrest challenged his administration. As a result of soaring prices, many city workers demanded pay raises. Figueiredo allowed unions to strike for higher wages, and about 300 of them staged strikes in 1979. Figueiredo also reacted to the growing desire for increased political rights by allowing new political parties.

Return to civilian government. Military rule ended in Brazil in 1985. In January, the electoral college elected a civilian president, Tancredo de Almeida Neves. The college consisted of the members of Congress and the state legislatures. Neves became too ill to take office. José Sarney, the elected vice president, became interim president. In April, Neves died, and Sarney was named president. A 1985 constitutional amendment provided for direct election of future presidents by the people. In 1986, Brazilians elected a new Congress and new state legislatures and governors in the first nationwide general election after military rule ended. In December 1989, the people elected Fernando Collor de Mello president.

In 1992, Brazil's Chamber of Deputies impeached Collor on charges that he was involved in a corruption ring selling political favors. Shortly after the Senate opened an impeachment trial, Collor resigned. Itamar Franco, Collor's vice president, became president in December 1992. Collor still faced a charge of corruption in civil court. He was acquitted in 1994.

In October 1994, Fernando Henrique Cardoso became president. He was reelected president in 1998.

J. H. Galloway

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Outline

I. Government
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VII. History

Questions

How does Brazil rank in area among all countries?
What are the three main land regions of Brazil?
What are some of the problems in Brazil's favelas?
Where was the city of Brasília built? Why?
What is the minimum voting age in Brazil?
Why did Portugal bring African slaves to Brazil?
How much of the world coffee crop comes from Brazil?
What is the most popular sport in Brazil?
What is Brazil's official language?
How do Brazilian farmers "grow" fuel?

Additional resources

Eakin, Marshall C. *Brazil.* 1997. Reprint. St. Martin's, 1998.
Fausto, Boris. *A Concise History of Brazil.* Cambridge, 1999.
Levine, Robert M. *Brazilian Legacies.* M. E. Sharpe, 1997. *The History of Brazil.* Greenwood, 1999.
Morrison, Marion. *Brazil.* Raintree Steck-Vaughn, 1997. Younger readers.

Brazil nut, also called *para nut,* comes from a large, evergreen tree found mainly in forests near the Amazon River and its tributaries in northern Brazil, Guyana, and Venezuela. The tree grows up to 150 feet (46 meters) tall. In old trees, the trunk at the base varies from 4 to 6 feet (1.2 to 1.8 meters) wide. The trees develop long, straight trunks. The wavy leaves are bright green and leathery and often grow about 1 foot (30 centimeters) long.

The nuts are the seeds of the tree. They form inside roundish or pear-shaped woody fruit. Each fruit has from 12 to 24 nuts. The nut kernels are rich in oil and delicious to eat. Oil crushed from the kernels is used for salads. Low-grade oil is used in making soap. The fruits ripen from November to June. Force must be used to cut open the $\frac{1}{4}$-inch (6-millimeter) shell of the fruit, and then the hard seed coats must be removed.

Richard A. Jaynes

Scientific classification. The Brazil nut belongs to the lecythis family, Lecythidaceae. It is *Bertholletia excelsa.*

See also Cannon-ball tree.

Brazilian literature. See Latin-American literature.

Brazilwood is the common name of several dyewood trees of Brazil. *Pernambuco,* also called *Bahia wood,* is a kind of brazilwood that may grow over 100 feet (30 meters) high. When cut, its wood is bright orange to orange-red. It becomes more reddish when dry. Brazilwood was once an important source of dye and is still used for making violin bows. Jim L. Bowyer

Scientific classification. Brazilwood is in the pea family, Fabaceae or Leguminosae. The scientific name for pernambuco is *Caesalpinia echinata.*

Brazing. See Welding (Brazing and soldering).

Brazzaville, *BRAZ uh vihl* or *BRAHZ uh VEEL* (pop. 596,200), is the capital and largest city of the Republic of the Congo, also known as Congo (Brazzaville). It lies along the Congo River, across Stanley Pool from Kinshasa, Congo (Kinshasa). For location, see the map in the article Congo (Brazzaville).

Brazzaville is an industrial and transportation center. Local factories manufacture building and food products, cigarettes, furniture, matches, shoes, and textiles. Several tanneries also operate in the city. The Congo-Ocean railroad, about 320 miles (515 kilometers) long, links Brazzaville to Pointe-Noire, on the Atlantic coast. Most exports and imports of the inland countries of the Central African Republic and Chad move through Brazzaville to and from the coast.

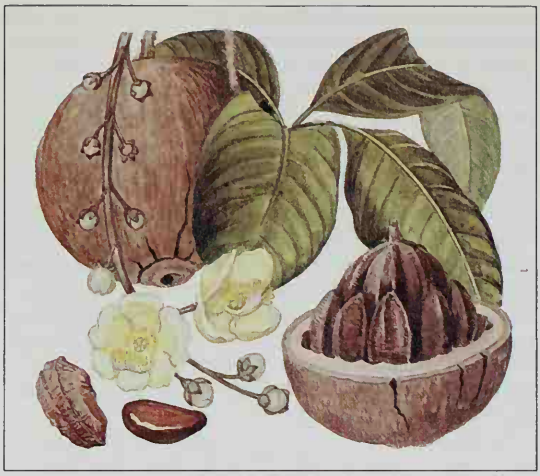
Brazzaville was founded in 1880 by the French explorer Pierre Savorgnan de Brazza. It was the capital of the former French Equatorial Africa from 1910 to 1958. During World War II (1939-1945), it was headquarters for the Free French forces in Africa. Thousands of Brazzaville's people were killed and many of the city's buildings were damaged or destroyed during a civil war in 1997.

Samuel Decalo

See also Congo (Brazzaville) [picture].

Breach of promise is the legal term for breaking an agreement to marry. A court cannot force anyone to marry. But some states of the United States allow the jilted person to sue for damages if the other person broke the engagement without sufficient reason.

Breach of promise suits have existed in law since the 1600's, when many people chose marriage partners for financial or other practical advantages. Families helped arrange many matches, especially among people with property. These people were the ones most able to afford a suit if the promise to marry was not kept.



WORLD BOOK illustration by Kate Lloyd-Jones, Linden Artists Ltd.

The Brazil nut is the seed of a South American tree. The nuts, which have a hard seed coat, grow inside the tree's fruit.

As customs changed, many people came to believe that a person should choose a marriage partner for emotional rather than financial reasons. The damages in breach of promise suits became compensation for hurt feelings as well as for financial harm and loss of social standing. A jury has much freedom in deciding how much someone should pay for injuring another person's feelings in this way. A jury also may order damages as punishment if it believes the defendant acted intentionally to cause loss or suffering.

Some people criticize breach of promise suits because the amounts awarded seem excessive compared with the harm done. Others oppose such lawsuits because they enable a person to try to obtain money merely by threatening legal action. About 16 states have abolished these suits. Other states limit the amount of damages that can be awarded. Mary Ann Glendon

Breach of the peace is a term that includes disorderly conduct but is broader in its scope. Any act so different from the customs of a community that it disturbs or offends people is likely to be regarded as a breach of the peace. It is not a breach of the peace for a peddler to push a cart of vegetables through the street at noon, ringing a bell and shouting his or her wares. The same act at 4 a.m. would be a breach of the peace almost anywhere, because it would disturb many people who were then asleep.

When someone is accused of a breach of the peace, the court may set down some specific acts that will be regarded as a breach of the peace if the accused does them again. The accused is then "bound over to keep the peace." The court may ask the accused to put up a sum of money called a *peace bond.* The money will be forfeited if the accused does any of the specific acts.

The term *breach of the peace* began in the days when the king was supreme in England. It was held that the king had a right to peace within his realm. Whenever any crime was committed against the royal laws, the of-

fender was arrested for disturbing "the king's peace" and was tried before a justice of the peace. Today, a serious crime is not spoken of as a breach of the peace. The term is used only for offenses that invade the right of people to live in peace and quiet, and that are not covered by any other statute. George T. Felkenes

Bread is the most widely eaten food. It provides a larger share of people's energy and protein than any other food and is often called the *staff of life.*

Bread is made by baking dough that consists chiefly of flour or grain meal mixed with water or milk. The people of many Western countries eat bread baked mainly as loaves or rolls made with wheat flour. In some other parts of the world, people eat thin, crisp sheets of bread called *flat bread.* Flat bread is made either from such grains as barley, corn, oats, rice, rye, and wheat, or from flour milled from these grains.

In many parts of the world, people make bread by hand much as ancient bakers did. In the United States and many other industrial nations, however, most bread is made by machine in commercial bakeries.

Kinds of bread. Bread may be divided into three main types: (1) yeast bread, (2) quick bread, and (3) flat bread. Yeast bread is *raised* (puffed up) by yeast. Quick bread requires less preparation time before baking than yeast bread. It is raised by the use of baking powder or some other *leaven,* a substance that raises dough. Flat bread contains little or no leaven. It takes about as long to prepare before baking as quick bread.

Yeast bread includes *pan bread, hearth bread,* and other yeast-leavened goods. Pan bread, which is baked in a container, includes bread made with white wheat flour and such specialty breads as raisin bread and whole-wheat bread. Hearth bread, which includes French bread and most rye bread, is baked on a flat pan or placed directly on the *hearth* (floor) of an oven. Other yeast-leavened goods include hamburger and frankfurter rolls and *brown-and-serve* (partially baked) rolls.

Quick bread includes corn bread, doughnuts, muffins, and pancakes. Most quick bread is baked at home or in local bakeries and supermarkets.

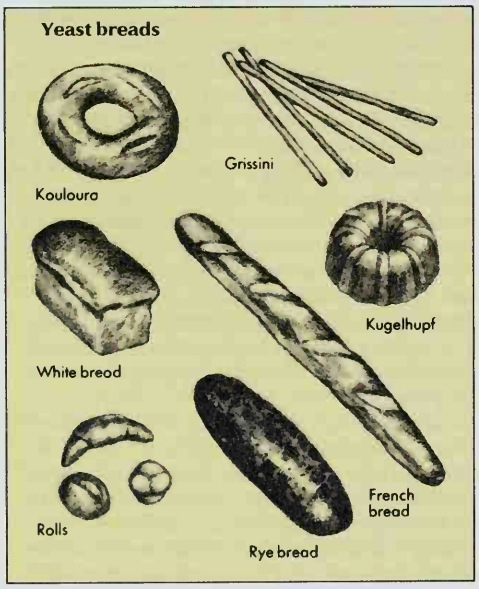
Flat bread is a major food in many parts of the world. Central Americans eat various flat breads made from corn or wheat flour, called *tortillas.* People in the Far East make several types of flat bread from rice flour. The people of India eat a flat bread called *chapatti,* which includes coarsely ground wheat. In the Middle East, a flat bread called *pita bread* is made from durum wheat.

How yeast bread is made. Both commercial bakers and home bakers make bread from a dough that consists of at least four ingredients—flour, water or milk, salt, and yeast. The dough may also contain eggs, shortening, sugar, or other foods.

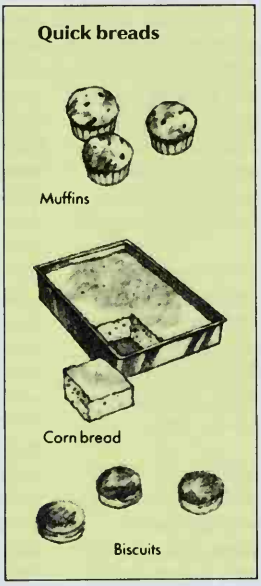
Most commercial bakers in the United States and many other countries use enriched dough for white bread. They enrich their dough by adding vitamins and minerals, or they use already enriched flour. Most commercial dough also contains substances called *dough conditioners* and *shelf-life improvers.* Dough conditioners, such as chlorine dioxide and potassium bromate, help give bread a smooth, even texture. Shelf-life improvers include monoglycerides, which help keep bread from becoming stale, and calcium propionate, which reduces the growth of mold and bacteria.

Dough is made into bread by one of two processes, *conventional bread making* or *continuous bread making.* Conventional bread making is used by most bakeries. Home bakers also use variations of conventional bread

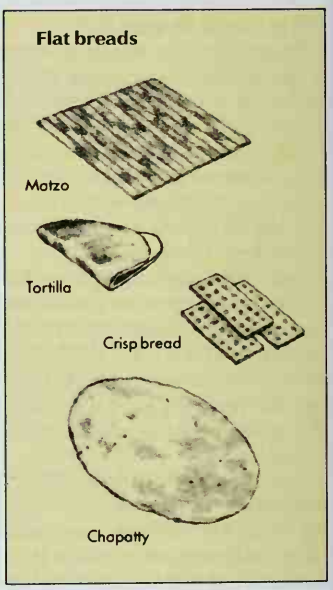
The three main types of bread



Yeast breads are eaten by most people in the United States, Canada, and many European nations. White bread is the most popular U.S. variety, but many Americans also like rye, whole-wheat, and French bread.



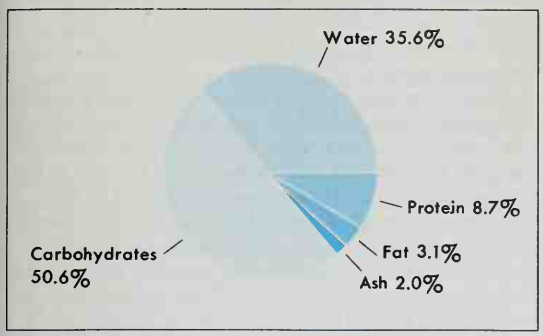
Quick breads, such as muffins and biscuits, are easy to make, and many people frequently bake them at home.



WORLD BOOK illustrations by David Cunningham

Flat breads are eaten by people worldwide. Latin Americans use tortillas in many dishes, and matzo is an important food among Jews.

Food values in white bread



Source: U.S. Agricultural Research Service.

making. Continuous bread making is used by only the largest bakeries.

In conventional bread making, the ingredients are mixed by one of two chief methods, the *sponge-and-dough method* or the *straight dough method*. In the sponge-and-dough method, the ingredients are combined in two stages. The first stage mixes all the yeast and about two-thirds of the flour and water or milk. This mixture is called a *sponge*. Bakers let the sponge *ferment* (rise) at about 85 °F (29 °C) for up to 16 hours. Then they add the rest of the ingredients, and the mixture ferments again for a short time. In the straight dough method, all the ingredients are combined at once and fermented for about 3 hours at 85 °F (29 °C).

After either of these fermenting processes, the dough is divided into pieces and shaped. It is then fermented again for a short time in a process called *proofing* and baked in an oven at about 450 °F (232 °C).

Continuous bread making uses highly specialized equipment to mix the ingredients and prepare the dough for baking. In the most common method, all the ingredients except the flour are first combined to form a mixture called a *broth*. After fermenting in a tank, the broth is pumped to a mixer and the flour is added. In the mixer, the ingredients are combined under pressure to form dough. The dough is then divided, shaped, and sent to an oven for baking. This process produces bread of uniform shape, texture, and quality.

After bread has been baked, it is removed from the oven to cool. In commercial bakeries, the loaves are placed in cooling machines where their temperature is reduced to about 100 °F (38 °C). The bread may then be sliced and wrapped in paper or plastic film.

The food value of bread. Enriched white bread provides important amounts of protein, starch, iron, and three B vitamins—niacin, riboflavin, and thiamine. Milling removes from wheat most of these substances, which are naturally present in the grain.

Whole-wheat bread provides almost all the natural vitamins and minerals of wheat, including niacin, riboflavin, thiamine, vitamin E, and iron and calcium. Whole-wheat bread also contains bran, an important source of fiber. White bread has little fiber.

History. Prehistoric people made flat bread by mixing grain meal with water and baking the resulting dough on rocks that they had heated. Historians believe the Egyptians learned to make yeast bread about 2600 B.C. The ancient Greeks learned bread making from the Egyptians and later taught the method to the Romans. By the A.D. 100's, the Romans had taught the technique to people in many parts of Europe. In the Middle Ages, most European cities had bakeries.

For hundreds of years, most people ate whole-wheat bread or other kinds of whole-grain bread. White wheat flour was extremely expensive because milling it required hours of hand labor. During the late 1800's, millers developed machinery that milled white flour inexpensively. By 1900, white bread was a common food.

Commercial bakeries were established in the American Colonies as early as 1640. But until the 1900's, most bread was baked at home. Both homemade and commercial bread were made by hand. During the 1920's, many United States bakeries became mechanized.

In the 1930's, U.S. public health officials reported a large number of cases of *beriberi* and *pellagra*. These diseases are caused by a lack of B vitamins. In 1941, many U.S. bakeries agreed to begin enriching white bread with B vitamins and iron to fight the diseases. Almost all the nation's bakeries have sold enriched white bread since the mid-1950's, and beriberi and pellagra are now rare in the United States. Kay Franzen Jamieson

Related articles in *World Book* include:
Carbohydrate
Colonial life in America (Food and drink)
Flour
Gluten
Rye (Uses)
Wheat (Food for people)
Yeast

Breadfruit is a tropical fruit native to the Pacific Islands. It gets its name from its edible starchy pulp, which some people think tastes and feels like bread.

Breadfruit varies in shape from round to oval. In most cases, the ripe fruit weighs from 1 to 5 pounds (0.5 to 2.25 kilograms) and has a rough, brownish-yellow skin. The pulp ranges in color from white to yellow. Some types of breadfruit contain seeds. People bake, boil, or fry breadfruit, and they sometimes use it like potatoes in salads and stews. The seeds, which are also edible, are boiled or roasted. Breadfruit grows on large-leafed trees that are 65 to 95 feet (19 to 29 meters) tall. These trees grow in rich, well-drained soil in tropical lowland areas. Breadfruit is produced commercially mainly on islands in the Caribbean Sea and Pacific Ocean, including Hawaii. Philip J. Ito

Scientific classification. The breadfruit tree is in the mulberry family, Moraceae. It is *Artocarpus altilis*.

Breakbone fever. See Dengue.

Breakspear, Nicholas. See Adrian IV.

Breakwater is a wall that protects a harbor, coast, or offshore structure from strong waves. Breakwaters also create a calm area where ships can anchor. Some breakwaters provide temporary protection while construction or mineral exploration takes place. Waves lose much of their energy as they strike a breakwater.

Some breakwaters are built as mounds of soil, rock, or concrete. Other breakwaters are built of *sheet piles*—that is, closely spaced planks of timber, steel, or concrete that are driven into the bottom of the lake or sea. In some cases, piles are placed in two rows and the space between them is filled with rocks. The kind of breakwater used depends partly on the condition of the lake or sea bottom. For example, a soft bottom might require the use of sheet piles. A firm bottom would proba-

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A breakwater in Lake Michigan protects a Chicago harbor, shown here, from the force of rough waves.

bly support a mound. The design must also take into account the action of waves in the most severe storm expected over a long period. William E. Saul

See also **Jetty**.

Bream is the name of various kinds of stout-bodied fish. In North America, the name *bream* is given to several marine fish related to porgies, scups, and pinfish. The most common species, the sea bream, grows to about 12 inches (30 centimeters) in length. It lives in the Caribbean Sea and in coastal waters off southern Florida. It is bluish-silver with narrow bronze stripes.

In Europe, the word *bream* refers to any of three large species of minnows. A species that is named the bream is commercially important. This fish is abundant in lowland rivers of western Europe. It breeds in shallow waters along riverbanks in the spring. The other types are the silver bream and the blue bream. John E. McCosker

Scientific classification. North American breams belong to the porgy family, Sparidae. The sea bream is *Archosargus rhomboidalis.* European breams belong to the family Cyprinidae. The bream is *Abramis brama;* the silver bream, *Blicca bjoerkna;* and the blue bream, *Abramis ballerus.*

Brearley, *BREHR lih,* **David** (1745-1790), a lawyer and judge from New Jersey, was a signer of the Constitution of the United States. At the Constitutional Convention of 1787, Brearley helped New Jersey delegate William Paterson present a plan that would have given each state an equal number of representatives in the national legislature. But the plan was rejected. Brearley was president of the New Jersey state convention that *ratified* (approved) the Constitution in 1788.

Brearley was born in Spring Grove, New Jersey. After attending the College of New Jersey, he practiced law in Allentown, New Jersey. During the Revolutionary War in America (1775-1783), Brearley served as a lieutenant colonel. From 1779 to 1789, he was chief justice of the New Jersey Supreme Court. In the *Holmes v. Walton* case of 1780, Brearley ruled that the judiciary has the right to decide whether laws are constitutional. This right, known as *judicial review,* became a key principle of American constitutional thought. In 1789, Brearley became a U.S. district court judge. Richard D. Brown

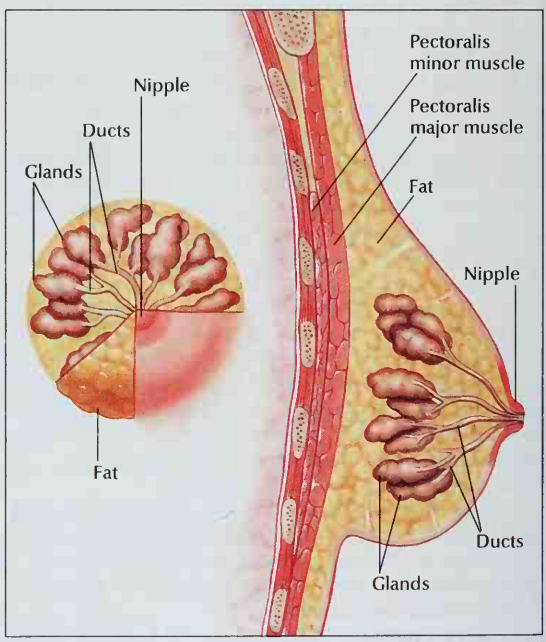
Breast is an organ specially designed to produce milk to feed a baby. Human beings have two breasts, but only those of mature females can produce milk. The breasts of males do not develop fully because males lack the female hormone pattern required for breast development. Breasts are also called *mammary glands,* especially when referring to those of nonhuman mammals. See **Mammary glands**.

Breasts probably evolved from some type of secreting skin gland. In female breasts, secreting cells arranged in tiny *lobules,* also called *acini,* form the glands that make the milk. A network of *ducts* (tubes) carry the milk to the nipple. The ducts and glands are surrounded by fatty and fibrous support tissue and enclosed by skin. The organ rests on the *pectoralis major muscle* on the chest.

A female's breasts begin to grow around age 10 to 12, and they continue to develop until she is about 16 to 18 years of age. Breasts may be affected by changes in the levels of hormones in a woman's blood. For example, the breasts may swell and become painful or lumpy before menstruation. After menstruation, the pain or lumpiness usually goes away. See **Menstruation**.

When a woman becomes pregnant, the ducts and glands in her breasts enlarge. As soon as the baby is born, hormones in the mother's body start the *lactation* (milk-making) process. The baby's sucking of the nipples also stimulates lactation. A mother's milk is a complete source of food and energy for the baby. It also contains antibodies that protect the infant from many diseases.

Breast cancer is the most common form of cancer among women. The best way to fight the disease is by detecting it early. *Mammography* (X-ray examination of the breast) is the best tool for early detection. In addition, women over the age of 20 should practice breast self-examination once a month. With her fingers flat, a woman should feel her breasts for lumps. She also should visually inspect the breasts for any changes and



WORLD BOOK illustrations by Charles Wellek

The female breast consists chiefly of fatty tissue. After a baby is born, special glands in the mother's breasts form milk, which is carried to the nipples by a network of ducts.

check the nipples for fluid discharge. Women who discover any of these changes should promptly see a physician. Melvin J. Silverstein

See also **Breast cancer; Mammography.**

Breast cancer is an uncontrolled, potentially deadly division of cells in the breast. In the United States, breast cancer is the most common women's cancer. According to the American Cancer Society and the National Cancer Institute, an average of 1 American woman in 8 will develop breast cancer sometime during her life. Women in Africa and Asia have a lower risk of breast cancer than do women in North America and Europe. A small number of men also develop breast cancer.

The risk of breast cancer increases for all women as they grow older. A woman's risk also increases if a relative, especially her mother or a sister, has also had the disease. Scientists have found two rare abnormal genes, called *BRCA1* and *BRCA2*, that greatly increase risk. Tests to detect these genes are available, but doctors disagree about when such tests should be given. Most women with one or two relatives who have had breast cancer do not have inherited genetic abnormalities.

A painless lump is the most common symptom of breast cancer. Doctors advise women to examine their own breasts for lumps every month. A breast X ray called a *mammogram* can detect many cancers before they can be felt. Most doctors recommend that women begin having annual mammograms at age 40 to 50.

Doctors usually begin treatment of breast cancer by surgically removing the tumor. When the cancer is small, a *lumpectomy* can preserve the breast. In this operation, a surgeon removes the cancerous lump and a margin of the normal tissue surrounding it. The breast is then treated with radiation to kill stray cancer cells. If the cancer is large, the entire breast must often be removed in a *modified radical mastectomy* (see **Mastectomy**).

In either a lumpectomy or a mastectomy, doctors also remove and examine *lymph nodes* from the armpit. These nodes are small masses of tissue that help the body fight disease by filtering out bacteria and other harmful particles. Cancer in the lymph nodes indicates a high risk that the tumor will reappear elsewhere in the body. A tumor that is especially large or has extremely disorganized cells may also increase risk of renewed cancer even if the lymph nodes are healthy. If the tumor will likely reappear, doctors offer additional treatments.

To determine the best treatment, doctors test some cancer cells to see if female hormones make them grow. If the cells respond, doctors may prescribe the drug *tamoxifen* to block the action of these hormones. If hormones have no effect, or if the patient still has menstrual periods, doctors may use *chemotherapy* (drugs that have a toxic effect on a disease). Both tamoxifen and chemotherapy significantly reduce the risk of cancer returning. Some studies also suggest that tamoxifen and the drug raloxifene significantly lower the likelihood of developing breast cancer for healthy women with an increased risk for the disease. Monica Morrow

See also **Breast; Cancer; Chemotherapy; Mammography; Tamoxifen.**

Breasted, James Henry (1865-1935), an American archaeologist, became one of the world's leading authorities on the archaeology and history of Egypt and the Near East. In 1919, with financial aid from John D. Rockefeller, Jr., he founded the Oriental Institute of the University of Chicago. It became the world's leading center for the study of Near Eastern history and civilizations.

Under the direction of Breasted, the Oriental Institute carried out many important archaeological excavations. These excavations included the uncovering of Megiddo (ancient Armageddon) in Palestine. Breasted's dates for the various periods of ancient Egyptian history are the ones usually followed by scholars throughout the world. He wrote *History of Egypt from the Earliest Times to the Persian Conquest* (1905), *The Conquest of Civilization* (1926), and *The Dawn of Conscience* (1933).

Breasted was born on Aug. 27, 1865, in Rockford, Illinois. He studied at Yale University and the University of Berlin. He joined the faculty of the University of Chicago in 1894. He was professor of Egyptology and Oriental history there from 1905 until his death. David B. Stout

Breath testing is the analysis of a sample of air from the lungs to determine the concentration of certain chemical substances in the body. It is used most often to determine the amount of alcohol a person has consumed where drunken driving is suspected. The technique can also be used to detect other chemical substances in the body and even diagnose some diseases.

Breath testing for alcohol is based on the principle that the concentration of alcohol in a person's breath is proportional to the amount in the person's blood. Consumed alcohol becomes more *volatile* (quick to evaporate) when warmed by the body. Some alcohol passes from the blood into air inside the lungs. The concentration of alcohol in the blood can be determined from air blown into a test device, sometimes called a *breathalyzer*. The result is usually displayed as a percentage.

A device called an *evidential breath tester* provides a reliable measure of blood alcohol concentration (BAC) that is accepted by many courts as evidence. Research indicates that a driver may become impaired with a BAC as low as 0.02 percent. This means that there is 0.02 gram of alcohol per 100 milliliters of blood in the person's body. Most experts agree that any person whose BAC reaches 0.08 percent is too impaired to drive safely.

The minimum BAC necessary to convict a suspected drunken driver varies from country to country and from state to state within the United States. In 2000, President Bill Clinton signed a law requiring all U.S. states to adopt a 0.08 percent breath alcohol level limit by 2003.

J. Robert Zettl

Breathing. See Respiration.

Brébeuf, *bray BUF,* **Saint Jean de,** *saynt zhahn duh* (1593-1649), was a French Jesuit missionary and martyr. He established the first mission among the Huron Indians on Georgian Bay, Canada, in 1626. To convert them, he underwent great hardships. The Iroquois tribe, enemies of the Huron, captured and killed him in 1649. Brébeuf was born on March 25, 1593, in Bayeux, France.

James A. De Jong

Brecht, *brehkt,* **Bertolt,** *BEHR tawlt,* also spelled *Bertold* (1898-1956), was an important German playwright. Brecht tried to show that social forces determine human nature, and that the evils of capitalism brutalize the poor and make the rich corrupt.

Brecht believed that an audience's emotional involvement in the characters and action tends to cloud its grasp of the play's message. In his so-called *epic theater*

style, he tried to shatter traditional stage illusions of reality by using various visual techniques and an unemotional acting style. For example, performers would "read" their lines in a deliberately expressionless manner. To Brecht, such a device allows the audience to focus on the lessons to be drawn from the play. Brecht's plays advocate changes in middle-class society.

Brecht wrote several dramas before 1925. The first was *Baal,* written in 1918 and 1919 and first performed in public in 1923. Brecht gained his greatest success with *The Threepenny Opera* (1928). Including adaptations of other works, Brecht wrote about 35 plays. They include *Galileo* (1945), *Mother Courage* (1946), *The Good Person of Setzuan* (1947), and *The Caucasian Chalk Circle* (1948). Brecht also gained fame for his poetry and wrote a number of works of prose fiction.

Brecht was born in Augsburg. He left Germany when the Nazis came to power in 1933, and lived in the United States from 1941 to 1947. In 1949, he moved to East Berlin and formed the Berliner Ensemble. Siegfried Mews

Breckinridge, John Cabell (1821-1875), was vice president of the United States and, later, a Confederate general in the American Civil War. Breckinridge served as vice president from 1857 to 1861, under President James Buchanan. He took office at the age of 36 and is the youngest person ever to serve as vice president. In 1860, the Southern wing of the divided Democratic Party nominated him for president. Breckinridge came in second in the four-candidate presidential election, losing to Republican Abraham Lincoln. The Civil War began in 1861, soon after Lincoln took office.

As a Confederate general, Breckinridge fought in many battles, including Shiloh, Stones River (Murfreesboro), Vicksburg, Jackson, and Chickamauga. He was Confederate secretary of war in 1865.

Breckinridge was born near Lexington, Kentucky. He served in the U.S. House of Representatives from 1851 to 1855. In 1861, Breckinridge became a U.S. senator. But he was soon expelled from the Senate because of his membership in the Confederate Army. Michael Perman

See also **Vice President of the United States** (picture).

Breckinridge, Sophonisba (1866-1948), was a pioneer teacher of social work in the United States. She taught social workers to work in a community as well as study its problems. She believed the government should play a key role in helping the needy.

Breckinridge was born in Lexington, Kentucky, and graduated from Wellesley College in 1888. In 1897, she became Kentucky's first woman lawyer. In 1904, Breckinridge joined the faculty of the University of Chicago, where she taught for 38 years. She helped establish the university's School of Social Service Administration in 1920. In 1927, she helped found the *Social Service Review,* a journal that she edited until her death. In 1934, she was elected president of the American Association of Schools of Social Work. Breckinridge wrote such books as *The Delinquent Child and the Home* (1912) and *The Family and the State* (1934). Miriam Schneir

Breda, *bray DAH* (pop. 129,125; met. area pop. 165,729), is a Dutch city about 27 miles (43 kilometers) southeast of Rotterdam. For location, see **Netherlands** (map). Breda produces machinery, electrical equipment, and food products. The Royal Military Academy is in the city.

Between 1577 and 1637, the Dutch and Spanish fought over Breda many times. In 1667, the Treaty of Breda brought to an end the Second Anglo-Dutch War. Under this treaty, the Netherlands officially recognized British control of New Netherland, a region in America that included parts of what are now Connecticut, Delaware, New Jersey, and New York. In return, the Dutch gained control of present-day Suriname. Jan de Vries

Breeder reactor. See **Nuclear energy** (Nuclear fission).

Breeding is the careful selection and pairing of plants, animals, and other organisms to improve the usefulness of their offspring. Although people have bred plants and animals for thousands of years, breeding became a science only after the early 1800's. This change occurred as scientists accumulated knowledge about how organisms inherit characteristics. See **Heredity; Genetics.**

There are two types of breeding: *selection* and *crossing.* Selection consists of identifying the most useful individuals of one kind of organism and letting only the best become parents of the next generation. Crossing involves pairing selected individuals to produce the best offspring possible. Crossing is called *hybridization* if the individuals are from different species or varieties or are themselves *hybrids*—that is, offspring of different varieties or species. Many breeders use computers to help determine the best individuals to breed.

Reasons for breeding. Breeding is normally done for a particular purpose, such as to produce plants and animals that grow faster or are better adapted to the climate in which they live. Each of the different kinds of wheat grown in Texas, Kansas, North Dakota, Canada, and India has been especially bred to grow in its particular climate. Breeding can also increase the size, strength, or resistance to disease of an organism. Breeders crossed imported grapevines with native American vines to produce grapes that resist certain diseases.

Plant breeding. The goal of plant breeding is to develop more or higher-quality food or natural fiber. Most of the plants that people grow and eat have resulted from the breeding of wild plants by selection. Almost every plant that has ever been raised has been improved or refined by breeding.

The greatest advances in plant breeding have resulted from combining selection and hybridization. Hybrid corn is a prominent example of a crop produced by repeated hybridization of selected parents. The use of selection alone has generally been more successful in wheat, barley, rice, and cotton production.

Animal breeding. Cattle, horses, sheep, hogs, and dogs are bred by selection to produce characteristics desired by the breeder. Breeders seek horses and dogs that are speedy or that have a particular hair color or physical shape. Most cattle, sheep, and hogs are bred to supply the largest amount of high-quality products at the lowest cost to the breeder.

Producing changes through breeding takes longer in animals than in plants. Changes take so long because animals are older than plants when they reproduce, and they have fewer offspring. Therefore, breeders usually try to improve only one quality of the animal at a time. For example, it is extremely difficult to breed a cow that is an excellent producer of both milk and beef. Thus, most breeders concentrate only on milk or only on beef.

Many breeders use a process called *artificial insemi-*

nation to improve the quality of their stock. The breeder collects *semen* (sperm-containing fluid) from an outstanding male and places it in the reproductive organs of a female. The semen can also be frozen and stored for future use, or transported to another location for use there. Artificial insemination is used widely in breeding cattle and poultry, and to a limited extent in other animals. It permits the best males to have many more offspring than would be possible by natural mating.

Breeders have also developed a method to increase the number of young from a superior female. This process, called *embryo transfer,* involves removing a fertilized egg from a high-quality female and transferring it to a healthy, but less valuable, female. Usually, the superior female is given a fertility drug so that she will produce a larger number of eggs than normal. Less valuable females carry the transplanted embryos through *prenatal* (prebirth) development and give birth to the young. Ben T. McDaniel

Related articles in *World Book* include:

Burbank, Luther	Hybrid
Eugenics	Livestock (Breeding livestock)
Evolution	Mutation
Flower (Flower breeding)	Pedigree

Breeding cycle. See Estrous cycle.

Breedlove, Craig (1937-), became one of the world's fastest automobile drivers in the 1960's. Breedlove set land speed records on a measured course at Bonneville Salt Flats in Utah. He set most of his early records in the *Spirit of America,* a three-wheeled, jet-powered car he designed and built. In 1963, he sped over the Bonneville course at 407.45 miles per hour (mph) or 655.73 kilometers per hour (kph), and became the first American to hold the world land speed mark since 1928. In 1964, he drove the course at 526.2 mph (846.8 kph). In 1965, he drove a four-wheeled, jet-powered car called the *Spirit of America-Sonic I* at 600.601 mph (966.574 kph). Norman Craig Breedlove was born March 23, 1937, in Los Angeles. Sylvia Wilkinson

Breed's Hill. See Bunker Hill, Battle of.

Bremen, *BREHM uhn* (pop. 551,219), is a commercial and industrial city in northwestern Germany. For location, see Germany (political map). Bremen serves as the capital of the state of Bremen.

Bremen lies on both banks of the Weser River, about 45 miles (72 kilometers) south of the North Sea, an arm of the Atlantic Ocean. Bremen's economy is based chiefly on shipping and trade. Other industries include shipbuilding, oil refining, food processing, and the production of automobiles, aircraft, electrical equipment, and textiles. Landmarks of Bremen include the Romanesque-Gothic Cathedral of St. Peter, begun in the 1000's; and the Gothic *Rathaus* (town hall), which dates from the early 1400's. Bremen University opened in 1970.

Bremen was founded sometime before A.D. 787, when it became a seat of bishops. In the 1300's, it gained economic importance through membership in the Hanseatic League—a confederation of north German cities (see Hanseatic League). Allied bombings badly damaged Bremen during World War II (1939-1945). The damaged areas were soon rebuilt. Melvin Croan

Brennan, William Joseph, Jr. (1906-1997), served as an associate justice of the Supreme Court of the United States from 1956 to 1990. He was appointed by President Dwight D. Eisenhower. On the court, Brennan strongly supported civil rights and individual liberties.

Brennan was born on April 25, 1906, in Newark, New Jersey. He graduated from the University of Pennsylvania and Harvard Law School. Brennan served on the New Jersey Superior Court from 1949 to 1952. From 1952 to 1956, he was a justice on the New Jersey Supreme Court. During the late 1950's and the 1960's, Brennan, a liberal, wrote landmark decisions on apportionment, free speech, school desegregation, welfare rights, and criminal procedure. In the 1970's, the Supreme Court began to become more conservative. As a result, Brennan often disagreed with the majority. Owen M. Fiss

See also Supreme Court of the United States.

Brenner Pass straddles the border between Austria and Italy at the eastern end of the Alps. It has an elevation of 4,508 feet (1,374 meters) and is the most accessible of the Alpine passes that link the Mediterranean region with the northern part of Europe. One end of Brenner Pass lies near the city of Bolzano, Italy, and the other end is at Innsbruck, Austria.

The ancient Romans used the Brenner Pass as a major link between Italy and the Germanic lands to the north. Later, Teutonic invaders of Italy crossed the pass. Medieval traders also traveled over the pass. In 1945, during World War II, United States Army units crossed Brenner Pass. Herbert H. Einstein

See also Alps (diagram: Some features; map).

Brent. See Brant.

Breslau. See Wrocław.

Brest (pop. 156,217; met. area pop. 210,055) is a seaport city on the northwest coast of France. For location, see France (political map). Brest is one of France's chief naval bases. It serves as a base for the country's nuclear submarines. The city's economy is based chiefly on shipping and economic activities generated by the naval base. Products of Brest include chemicals, clothing, electronic equipment, machinery, ships, and textiles.

Roman soldiers established a settlement in what is now Brest in the 50's B.C. Brest became a major shipping center following the construction of its harbor in the 1600's. German troops occupied the city in 1940, during World War II. Brest's harbor, protected by forts, was used by the Germans as a submarine base. Allied bombing raids destroyed much of the city, including its old central section, during the war. However, the bombed areas of the city were soon rebuilt. Mark Kesselman

Brethren is the name for several Protestant groups that developed from the Pietist movement in Germany in the 1600's and 1700's. The Pietists were Christians—primarily Lutherans—who rejected the emphasis on ritual and formal worship in their state church. They wanted to return to the simple life of the early Christians and live by the *literal* (exact) word of the New Testament. Some Brethren met in small groups for prayer and Bible study. They refused to take part in disputes between religious sects or to give their groups a name. They simply called themselves *Brethren* or *Christians.* As part of the Pietist movement, the Brethren originally acted with those who founded the Moravian Church and the Amana Society. See Moravian Church; Amanites.

With the Quakers and Mennonites, the Brethren are known as a *historic peace church.* They try to follow the simple standards of Christ's Sermon on the Mount.

Brethren refuse to take oaths, try to avoid violence, and refuse to fight in wars. They also emphasize service to people in need. The Brethren Service Commission carries on a vigorous program of international aid for victims of war and natural disasters. Brethren are devoted to Christian unity, and they take part in the national and world councils of churches.

Brethren immigrated to the United States between 1719 and 1740, and settled in Pennsylvania. Until recently, they have remained concentrated in rural Pennsylvania, Ohio, Indiana, and the Shenandoah Valley of Virginia. The strongest denomination in the United States is the Church of the Brethren, with about 1,000 congregations (see **Brethren, Church of the**). Smaller churches in the United States include the Brethren Church, the National Fellowship of Brethren Churches, and the Plymouth Brethren. Henry Warner Bowden

Brethren, Church of the, was organized in Germany in 1708 by Alexander Mack. The group was persecuted in Germany, and the church was reorganized in America in 1719 at Germantown, Pa. The religion spread through Pennsylvania, the Shenandoah Valley, and westward to the Pacific Coast. The church has sponsored mission work in India, China, Nigeria, Sudan, and Ecuador, and service work in Europe, Puerto Rico, Latin America, the Near East, and the Far East. It operates six colleges and a seminary. Headquarters are in Elgin, Ill. The church is a member of the World Council of Churches and the National Council of Churches of Christ in the United States.

A principle of the group is baptism by trine, or triple immersion, and they were once called *Dunkers* (from the German *tunken,* to immerse). Brethren believe in peace, brotherhood, temperance, and simple living. They teach the way of alternative service in place of military conscription.

Critically reviewed by the Church of the Brethren

Breton, *bruh TAWN,* **André,** *ahn DRAY* (1896-1966), was a French author and critic associated with two important movements in the arts. He participated in the activities of the dada group in Paris between 1919 and 1921. In 1924, Breton founded the surrealism movement, which he led until his death. See **Dadaism; Surrealism.**

Breton's *Manifesto of Surrealism* (1924), together with the essays of *Mad Love* (1937) and other writings, represents the movement's most important theoretical statement. Breton aimed at a revolution of the human spirit and a new way of life through the liberation of the subconscious mind. By freeing the imagination and "reimpassioning life," he argued, the numbing effects of reason and convention could be overcome and the full measure of love, poetry, and liberty experienced.

Two of Breton's prose works, *Nadja* (1928) and *Arcane 17* (1945), focus on the hidden forces of the mind that intersect everyday reality. His poems were written mostly by a process of free association. Breton influenced the development of nonrepresentational styles of art through his essay *Surrealism and Painting* (1928, rev. eds. 1946, 1965). He was born in Tinchebray.

Jean-Pierre Cauvin

Breton, *bruh TAWN,* **Jules Adolphe,** *zhool ah DAWLF* (1827-1906), was a French painter known for his sentimental scenes of peasant life. He painted rural subjects about the same time as the noted French artists Gustave Courbet and Jean François Millet. But the conservative French public of the Second Empire (1852-1870) rejected the work of Courbet and Millet as too realistic. They preferred Breton's idealized version of the peasant as healthy and satisfied with the social order. Breton's *The Gleaner* (1872) and *The Song of the Lark* (1884) are among his best-known pictures.

The Art Institute of Chicago, Henry Field Memorial Collection

Breton's *The Song of the Lark* is a famous example of the artist's paintings of French peasant life. Breton gained great popularity in the 1800's as a painter of sentimental rural themes.

Breton was born in Courrières, near Lens. In 1866, he was elected to the Academy of Fine Arts, a great honor for a painter of common rural themes. Richard Shiff

Bretons. See **Brittany.**

Bretton Woods is the popular name for the International Monetary Conference held at Bretton Woods, N.H., in July 1944. Representatives of 44 countries attended the conference. They made plans to stabilize the world financial system and foster the growth of trade after World War II. The representatives hoped to remove obstacles to long-term lending and international trade and payments.

The Bretton Woods Conference drew up the plans for two international organizations—the International Monetary Fund and the World Bank. The fund works to promote international financial stability by providing short-term assistance to help its members meet problems regarding balance of payments. The bank makes long-term international loans, especially to less developed countries. Robert M. Stern

See **International Monetary Fund; World Bank.**

Breuer, *BROY uhr,* **Marcel Lajos** (1902-1981), was a Hungarian-born architect, furniture designer, and teacher. From 1924 to 1928, Breuer taught at the

Bauhaus school of design in Germany. Although trained in architecture under Bauhaus director Walter Gropius, Breuer taught furniture design. In 1937, Breuer emigrated to the United States at the invitation of Gropius, who was teaching architecture at Harvard University. Breuer practiced architecture with Gropius from 1937 to 1941. He also taught at Harvard from 1937 until 1946, when he opened his own office in New York City. Although his practice was international in scope, Breuer designed important buildings in New York City, among them the Whitney Museum of American Art.

After moving to the United States, Breuer designed several important buildings in the European modern style pioneered by Gropius. Breuer also designed steel-framed furniture. A picture of his tubular steel-frame chair appears in **Furniture** (The 1900's). As a teacher, Breuer introduced a generation of American architects to the values and qualities of Bauhaus design. The most important of these architects included Philip Johnson and Paul Rudolph. Breuer was born in Pecs, Hungary.

Nicholas Adams

Brewing is the process used to make such alcoholic malt beverages as lager beer and ale. The chief ingredients used in brewing are barley malt and other cereal grains, as well as hops, yeast, and water. In the part of the brewing process called *fermentation,* the yeast converts the sugar obtained from the grains into alcohol. Most beers contain from 2 to 6 percent alcohol.

All brewers use the same basic brewing process. This article describes the basic process, which consists of six major steps: (1) malting, (2) mashing, (3) boiling, (4) fermentation, (5) aging, and (6) finishing.

Malting produces certain chemical and physical changes in barley, the chief grain used in making most beers. Barley malt contains starch and protein, as well as enzymes that are essential to the brewing process. Malt provides much of the flavor in beer.

To produce barley malt, brewers soak the barley in water from one to several days to increase its moisture content to the desired level. The barley is then placed in special chambers where it is allowed to *germinate* (sprout) for several days. Next, the barley is moved to large ovens called *kilns,* where it is dried and the germination process is halted. Brewers start the drying process at a low temperature and gradually increase the heat to 180 °F (82 °C). They then remove the sprouts and store the grain, now called malt, for a minimum of 4 weeks.

Mashing. Brewers grind the barley malt and mix it with water to form a mash. They also make a mash of other cereal grains, such as corn and rice. The mashes are combined and heated to about 155 °F (68 °C). During the heating process, enzymes in the malt liquefy the grain and convert the starch to sugar and other, more complex *carbohydrates* (substances composed of carbon, hydrogen, and oxygen). The mixture is filtered to remove grain kernels. The remaining amber liquid, called *wort,* is transferred to large kettles for boiling.

Boiling. During the boiling process, dried blossoms of the hop plant are added to the wort. The hops prevent spoilage and add aroma and flavor to the brew. After boiling, brewers clarify and cool the wort.

Fermentation. To promote fermentation, brewers add yeast to the wort. Yeast converts the sugar in the wort into alcohol and carbon dioxide. Brewers remove the carbon dioxide and store it for various uses in the brewery. Fermentation takes about a week. After fermentation, most of the yeast is removed from the brew.

Aging improves the taste of beer. Brewers age beer in storage tanks for several weeks or months. Some brewers age beer by fermenting it a second time.

Finishing. After the beer has been aged, brewers further clarify and filter it several times to remove the remaining yeast. The beer is then packaged in bottles, cans, or stainless steel kegs. Most bottled or canned

Jos. Schlitz Brewing Co.

In boiling wort, a liquid made from grain mashes, brewers use huge brew kettles, *above.* During this step of the brewing process, hops are added to the brew, giving it aroma and flavor.

Pabst Brewing Co.

Fermentation, which involves the conversion of sugar into ethyl alcohol, occurs in a fermentation tank, *above.* The brewmaster is drawing beer from the tank to check its quality.

Anheuser-Busch, Inc.

Packaging beer. Brewers package beer in kegs, bottles, and cans. Most bottled or canned beer is pasteurized before packaging. Kegs are filled and sealed in a racking room, *above.*

beer is pasteurized before being packaged.

History. Brewing was developed more than 6,000 years ago. Several ancient peoples, including the Babylonians and Inca, brewed beer. Large-scale commercial brewing began in Germany in the A.D. 1100's. A brewery established in 1632 in New Amsterdam (now New York City) was probably the first brewery in North America. Today the United States produces about 6 billion gallons (23 billion liters) of alcoholic malt beverages annually.

August A. Busch III

See also **Alcoholic beverage; Beer; Fermentation; Hop; Malt.**

Additional resources

Bamforth, Charles W. *Beer: Tap into the Art and Science of Brewing.* Insight Bks., 1998.
Hardwick, William A., ed. *Handbook of Brewing.* Marcel Dekker, 1995.

Brewster, William (1567?-1644), a spiritual leader of Plymouth Colony, was a founder of the Congregational Church in America. Brewster was born near Scrooby, England, and studied at Cambridge University.

In 1583, Brewster was employed by one of Queen Elizabeth I's ministers of state, Sir William Davison. Brewster traveled to the Netherlands in the 1580's but returned to Scrooby when Elizabeth unjustly imprisoned Davison for the beheading of Mary, Queen of Scots in 1587. For 17 years, Brewster served there as bailiff and postmaster. He became a leader of a group of Separatists, with whom he escaped to the Netherlands in 1608. He served there as a ruling elder and a printer, publishing religious books that displeased King James I of England. In 1620, Brewster came to America on the *Mayflower*. He became the chief spiritual leader because Plymouth often had no pastor. James Axtell

See also **Pilgrims; Plymouth Colony.**

Breyer, Stephen Gerald (1938-), became an associate justice of the Supreme Court of the United States in 1994. President Bill Clinton appointed Breyer to fill the vacancy created by the retirement of Justice Harry A. Blackmun.

Breyer was born in San Francisco. He graduated from Stanford University in 1959 and spent the next two years studying at Oxford University in England. In 1964, he earned a law degree from Harvard University.

In 1964 and 1965, Breyer served as a law clerk to U.S. Supreme Court Justice Arthur J. Goldberg. Breyer began teaching at Harvard Law School in 1967. In 1979 and 1980, he was chief counsel to the Senate Judiciary Committee. In November 1980, Breyer was appointed a judge of the U.S. Court of Appeals for the First Circuit, in Boston. He became the court's chief judge in 1990. On the Court of Appeals, Breyer gained a reputation as a moderate who had an unusual ability to bring about agreement among his colleagues. Sheldon Goldman

See also **Supreme Court of the U.S.** (picture).

Brezhnev, *BREHZH nyehf,* **Leonid Ilyich,** *LAY oh nihd ihl YEECH* (1906-1982), headed the Communist Party of the Soviet Union from 1964 until his death. In this position, he became the most powerful leader in the country. Brezhnev greatly increased Soviet military strength but could not solve growing economic problems.

Early life. Brezhnev was born in Kamenskoye (now Dneprodzerzhinsk) in what is now Ukraine. He studied surveying and became a land surveyor. He joined the Communist Party in 1931. That year, he entered night school at a metallurgical institute in Kamenskoye. After graduating, he served in the army for a year, then became a party official and director of a technical school.

Rise to power. During World War II (1939-1945), Brezhnev worked as a political adviser in the Soviet Army. He became allied with Nikita Khrushchev, a senior Communist Party official. After the war, Brezhnev held several high posts in the Communist Party. After Soviet dictator Joseph Stalin died in 1953, Khrushchev became head of the Communist Party. As Khrushchev's political fortunes rose, so did Brezhnev's.

In 1957, Brezhnev became a full member of the Presidium, the small group that ran the Communist Party. In October 1964, Brezhnev and other leaders forced Khrushchev to retire. Brezhnev replaced Khrushchev as leader of the Communist Party.

Policies. Brezhnev pursued stable relations and increased trade with Western countries, especially the United States. He signed several arms control treaties. But at the same time, he greatly increased Soviet military strength, kept tight control over Communist countries in Eastern Europe, and supported revolutionary movements in Asia and Africa.

In 1979, the Soviet Union invaded Afghanistan to support Afghanistan's Communist government against rebel forces. The United States and its allies condemned the invasion and adopted political and economic measures against the Soviet Union.

In domestic affairs, Brezhnev maintained the Communist Party dictatorship. The Soviet economy grew weaker in the 1970's. The war in Afghanistan was a failure. After Brezhnev's death, Soviet leader Mikhail Gorbachev blamed many of the country's problems on Brezhnev.

Stuart D. Goldman

See also **Union of Soviet Socialist Republics** (Brezhnev comes to power).

Additional resources

Millar, James R., ed. *Cracks in the Monolith: Party Power in the Brezhnev Era.* Sharpe, 1992.
Navazelskis, Ina L. *Leonid Brezhnev.* Chelsea Hse., 1987.

Brian Boru, *BRY uhn baw ROH* (940?-1014), was an Irish tribal chief who became King of Munster after 976, and High King of Ireland after 1002. His power was based in the South (Munster). He ended 200 years of domination by Norsemen and started a "Golden Age" of building, sponsoring restoration of the church and developing Irish culture. He unified about 100 small Irish kingdoms but was unable to give Ireland lasting political unity. He fought his greatest battle in 1014 against a group of Danes and Irish at Clontarf (now a suburb of Dublin), a victory that cost him his life. Thomas E. Hachey

Briand, *bree AHN,* **Aristide,** *a rees TEED* (1862-1932), was a French statesman who worked toward achieving peace in Europe. He served as France's premier 11 times.

Briand was born in Nantes, France. He began his career as a lawyer and a journalist. He became a leader of the French Socialist Party and was elected to France's Parliament in 1902.

Briand believed that French security required peace in Europe. He called for cooperation with France's for-

mer enemy, Germany. His efforts led to the 1925 Locarno treaties, including a pact in which Belgium, France, and Germany agreed never to fight each other again. Briand and Gustav Stresemann of Germany shared the 1926 Nobel Peace Prize for their work.

Briand and United States Secretary of State Frank B. Kellogg proposed the Pact of Paris, also known as the Kellogg-Briand Peace Pact. Over 50 nations eventually signed the pact, vowing not to go to war. Briand was Europe's leading supporter of the League of Nations, the forerunner of the United Nations. Gary B. Ostrower

See also **Kellogg-Briand Pact.**

Briar. See Brier.

Briard, *bree AHRD,* is a dog that was first bred in France, probably in the 800's. Briards are used to herd sheep. They also have carried supplies and served as guides and sentries in wars. Briards have black, *tawny* (tan), or gray coats of long, wavy hair. They stand from 22 to 27 inches (56 to 69 centimeters) at the shoulder and weigh from 60 to 90 pounds (27 to 41 kilograms).

Critically reviewed by the Briard Club of America

See also **Dog** (picture: Herding dogs).

Bribery is the crime of giving or receiving something of value to influence official action. Both the person giving and the person receiving the bribe are guilty of bribery.

Bribery is illegal for two reasons: (1) it usually involves a public official using his or her office for personal gain; and (2) it can cause officials to make unfair decisions that affect citizens. Bribery is a very old crime. There is evidence of bribery dating back more than 4,000 years.

Usually, a person who bribes a public official is paying to get special treatment. This special treatment can come in many forms. For example, a company might bribe an official to win a government contract.

Bribing a public official is the most common type of bribery. In the United States, officials convicted of bribery may be fined, removed from office, and sent to prison for up to 20 years. *Commercial bribery,* the bribery of owners or employees of private companies, is also illegal in many places, but it is less commonly punished.

No one knows how often people commit bribery, but many experts believe that most people who bribe officials are never caught. Bribery is more common in some countries or parts of countries than in others. Many countries have made it illegal to bribe officials from other countries. James Lindgren

Brice, Fanny (1891-1951), was an American comedienne and singer in musical comedy and on radio. From 1910 to the mid-1930's, she starred in many musical revues. She became popular for her comic routines in which she used a Yiddish accent. Brice also won fame for her moving performance of the love song "My Man," which she introduced in the *Ziegfeld Follies of 1921.* From 1936 until her death, Brice performed on radio, playing a 7-year-old brat named Baby Snooks.

Wide World

Fanny Brice

Brice was born in New York City. Her given and family name was Fannie Borach. Her comic singing in the *Ziegfeld Follies of 1910* made her a star. Gerald Bordman

Brick is a rectangular building block made of clay, shale, or various other materials. Bricks are strong, hard, and resistant to fire and damage from the weather. They are used to build such structures as houses, commercial and public buildings, fireplaces, and furnaces.

Bricks have been used as a building material for thousands of years. At first, people produced bricks by drying hand-shaped or molded blocks of clay or mud in the sun. Today, most bricks are formed by machines and *fired* (baked) in large *kilns* (ovens).

Kinds of bricks

Bricks are divided into two general groups: (1) building bricks, and (2) refractory bricks. Typical building bricks measure 2 $\frac{1}{4}$ inches (5.7 centimeters) thick, 3 $\frac{3}{4}$ inches (9.5 centimeters) wide, and 8 inches (20 centimeters) long. Refractory bricks are available in various sizes. Most are slightly larger than building bricks.

Building bricks. The highest-quality and most attractive building bricks are called *face bricks.* These bricks are used in highly visible areas of structures, such as the interior or exterior walls of houses. Face bricks come in a variety of colors and surface textures, and they are extremely uniform in shape and size. Most are made from high-grade fire clay or low-grade shale. Warped, off-color, and other slightly defective bricks are called *common bricks.* Common bricks are used in less visible places than are face bricks.

Refractory bricks, also called *refractories,* can withstand temperatures between 2000 and 4000 °F (1100 and 2200 °C). They are also highly resistant to chemical damage, physical wear, and *thermal cycling* (rapid changes in temperature). Refractories are used in a wide variety of structures, including fireplaces and industrial furnaces. Thin refractories are used on the outside of the United States space shuttles to provide protection against high temperatures. Refractories vary in composition according to their use. The main types are made from such raw materials as alumina, carbon, chrome ore, dolomite, fire clay, magnesite, silica, and zircon.

How bricks are made

The methods used to make bricks vary according to the raw material being used, the intended use of the brick, and other factors. However, the commercial production of bricks generally involves four basic steps: (1) preparing the raw material, (2) forming bricks, (3) drying bricks, and (4) firing bricks.

Preparing the raw material includes grinding or crushing it, removing its impurities, and letting it dry. The material is then stored in bins until it is mixed into brickmaking batches.

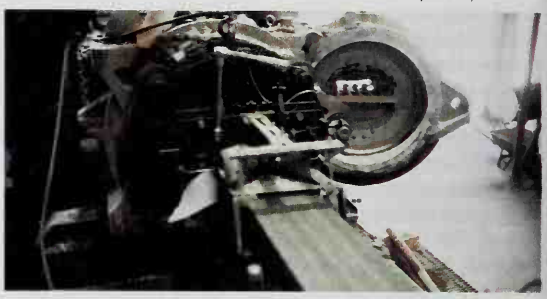
Forming bricks. There are three main processes used to form bricks: (1) stiff-mud, (2) soft-mud, and (3) dry-press.

The stiff-mud process is used to form by far the majority of building bricks produced in the United States. In this procedure, the ground brickmaking material is mixed with water to form a stiff mud. A machine presses air out of the mud and shapes the material into a long ribbon by forcing it through an adjustable opening in a

How bricks are made In industrialized countries, most bricks are made by machine. In the *dry-press* process, *below,* such raw materials as shale are crushed, mixed into brickmaking batches, and shaped into long ribbons. The ribbons are cut into bricks, which are stacked for drying and *firing* (baking).

WORLD BOOK photos by Dan Miller

Crushing the shale



Shaping a ribbon of brick

Cutting the bricks

Removing fired bricks from a kiln

process known as *extrusion.* The ribbon is cut into bricks by wires rotating on a machine called a *brick cutter.* The bricks can then be stacked for oven drying.

Before they are dried, many stiff-mud face bricks receive surface treatments to vary their texture and appearance. The bricks may be gouged, rubbed, or scraped, or they may be sprayed with chemical solutions that affect the surface. In addition, stiff-mud bricks are often made with holes in them. The holes make the bricks lighter and save on raw materials. The holes also provide additional space for *mortar,* the substance used in bricklaying to bind the bricks together.

The soft-mud process is used to produce all handmade and some machine-made bricks. In this method, the brickmaking material is mixed with more water than in the stiff-mud process. The soft mud thus produced is easily molded into bricks. Soft-mud bricks must be hardened by air drying before they can be stacked for oven drying. This step creates extra work and makes the soft-mud process slower than other brickmaking methods. In the United States, the soft-mud process is used mainly to produce specially shaped bricks that cannot be formed by other methods.

The dry-press process is used to form most refractory bricks. In this process, a dry or damp brick mix is placed into a steel mold box and compressed into brick form by a *hydraulic* (water-powered) ram. The ram may exert as much as 15,000 pounds per square inch (1,050 kilograms per square centimeter) of pressure on the mix. The resulting bricks are quite dense.

Drying bricks helps prevent them from developing cracks or other structural defects during firing. Most bricks are dried in *tunnel ovens.* These ovens can reach temperatures as high as 400 °F (204 °C). The bricks are stacked in layers on cars that move through the ovens. Drying time and temperature vary, depending chiefly on how much moisture the bricks contain.

Firing bricks at high temperature causes their particles to bond together, forming a strong, hard block. Most bricks are fired in *tunnel kilns.* The kilns generally range from 7 to 28 feet (2.1 to 8.5 meters) in width and 250 to 440 feet (76 to 134 meters) in length. They are fueled by gas, oil, or such solid fuels as sawdust or coal. They reach temperatures of 1800 to 2400 °F (1000 to 1300 °C) for firing building bricks and 3400 °F (1900 °C) for firing refractories.

In tunnel kiln firing, bricks are stacked on cars that move through the kiln. The ends of the kiln are not as hot as the middle. The bricks therefore are gradually heated to a maximum temperature in the middle of the kiln, and then they cool as they proceed out of the kiln. Different kinds of bricks are fired at different temperatures and for varying lengths of time, depending primarily on their grade and composition.

Some bricks are fired in *periodic* or *shuttle kilns.* These kilns can reach the same temperatures as tunnel kilns, but they fire only one batch of bricks at a time. In some areas, bricks are put in the sun to bake. Such bricks are called *sun-dried* or *sun-baked* bricks or *adobe* (see **Adobe**).

Bricklaying

Bricks are usually laid horizontally in layers called *courses.* The bricks are bound together with mortar,

which forms *joints* between them. In general, courses are arranged so that vertical joints do not fall directly above one another. Staggering the vertical joints distributes the weight and pressure of the bricks over a large area. A structure that is made of bricks is called *brickwork* or *brick masonry.*

Bonds. Bricks laid with their short ends exposed are called *headers.* Those laid with their long sides exposed are called *stretchers.* Headers and stretchers are arranged to form different *bonds* (patterns). The most commonly used bonds include *running, American, English,* and *Flemish.* In running bond, all the bricks are stretchers. American bond typically has four to six stretcher courses laid between single header courses. English bond consists of courses of headers alternating with courses of stretchers. The joints of every other course of English bond line up vertically. In Flemish bond, each course is made up of alternating headers and stretchers, with the headers centered on the stretchers above and below.

Mortar is used to hold both building and refractory brick structures together. However, the composition of the mortar differs with the type of brick and with structural needs.

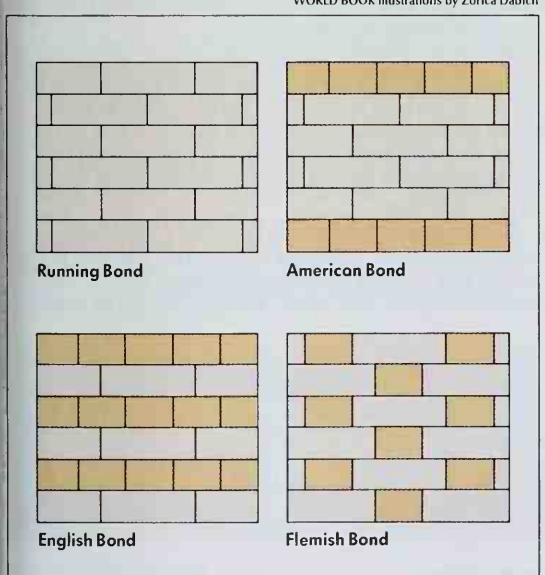
Mortar that is used to bind building bricks is composed of portland cement, lime, sand, and water. The mortar holds the bricks in position and makes a strong, tight wall that can resist moisture. The thickness of mortar joints between building bricks ranges from $\frac{1}{4}$ to $\frac{1}{2}$ inch (6.4 to 13 millimeters). Bricklayers form the joints by smoothing mortar on the bricks with a wedge-shaped tool called a *trowel.*

Mortar used to bind refractory bricks must be able to withstand the same high temperatures, chemical reactions, and wear as the bricks themselves. Refractory mortar consists of calcium aluminate cement, water, and a finely ground hard material similar in composition to the bricks being joined. Mortar joints between refractory bricks are no thicker than $\frac{1}{16}$ inch (1.5 millimeters). Extremely thin joints are made by dipping the bricks into soupy mortar and then pressing them together.

Chief bonds used in bricklaying

Bricks are usually laid horizontally in layers known as *courses.* The bricks are arranged in patterns called *bonds.* Bonds distribute the weight and pressure of the bricks over a large area. Four of the most commonly used bonds are shown below.

WORLD BOOK illustrations by Zorica Dabich



History

Brick is the oldest manufactured building material. Sun-dried bricks were being made in the Middle East by 6000 B.C. Fired bricks were being produced in the same region by 3500 B.C. Brickmaking technology was later spread to much of Europe by the Romans.

Brickmaking declined in England during the Middle Ages (about the A.D. 400's to the 1500's) due to changes in architectural styles and availability of wood, stone, and other building materials. But the brickmaking industry grew following the Great London Fire of 1666. Many of the buildings in the city had been made of wood and were therefore destroyed by the fire. When the city was rebuilt, many of the new buildings were constructed of brick.

In what is now the United States, the Indians of the Southwest built houses of adobe long before the arrival of European settlers. The commercial production of bricks in America began in the 1600's.

Brick was used to pave streets and sidewalks until the 1900's, when it was largely replaced by concrete for paving. Today, building bricks remain important construction and decorative materials. Refractory bricks play an important role in many industrial procedures, including the production of aluminum, cement, glass, iron, paper, petroleum, and steel. Charles E. Semler

See also **Adobe; Building trade; Clay.**

Bricker, John William (1893-1986), was the Republican candidate for Vice President of the United States in 1944. He and presidential candidate Thomas E. Dewey were defeated by President Franklin D. Roosevelt and Harry S. Truman. Bricker served as governor of Ohio from 1939 to 1945. He was elected to the United States Senate in 1946, and was reelected in 1952.

Bricker was born in Madison County, Ohio. He received a bachelor's degree and a law degree from Ohio State University. James H. Rodabaugh

Bridal wreath is a shrub that belongs to the rose family. It is found in temperate regions and grows about 6 feet (1.8 meters) high. It has slender, curving branches and dark green leaves that turn orange in autumn. The leaves are smooth and oblong and may have cut edges. The flowers bloom in April and May. These white flowers are about $\frac{1}{3}$ inch (8.5 millimeters) across and grow in clusters.

Scientific classification. Bridal wreath is in the rose family, Rosaceae. It is *Spiraea prunifolia.* J. J. Levison

See also **Rose; Spiraea.**

Bridalveil Fall is one of the most beautiful sights of Yosemite National Park, Calif. The fall drops a misty curtain of water from a height of 620 feet (189 meters) of colorful rock. Sometimes the wind strikes the fall in such a way as to send sprays of water back over the cliff from which it fell. Then the fall seems like the veil of a bride.

Bride, Saint. See Bridget, Saint.

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The Golden Gate Bridge is one of the world's longest suspension bridges. It has a main span of 4,200 feet (1,280 meters) and a total length of 8,981 feet (2,737 meters). The bridge spans a channel of San Francisco Bay and links San Francisco with Marin County, California.

Bridge is a structure used by people and vehicles to cross areas that are obstacles to travel. Engineers build bridges over lakes, rivers, canyons, and busy highways and railroad tracks. Without bridges, people would need boats to cross waterways and would have to travel around such obstacles as canyons and ravines.

Bridges range in length from a few feet or meters to several miles or kilometers. A bridge must be strong enough to support its own weight as well as the weight of the people and vehicles that use it. It also must resist natural occurrences, including earthquakes, strong winds, and changes in temperature. Most modern bridges have a concrete, steel, or wood framework and an asphalt or concrete *roadway.* The roadway is the part of a bridge on which people and vehicles travel.

Most bridges are held up by at least two supports set in the ground. The distance between two adjacent supports is called a *span* of a bridge. The supports at each end of the bridge are called *abutments,* and the supports that stand between the abutments are called *piers.* The total length of the bridge is the distance between the abutments. Most short bridges are supported only by abutments and are known as *single-span bridges.* Bridges that have one or more piers in addition to the abutments are called *multi-span bridges.* Most long bridges are multi-span bridges. The *main span* is the longest span of a multi-span bridge.

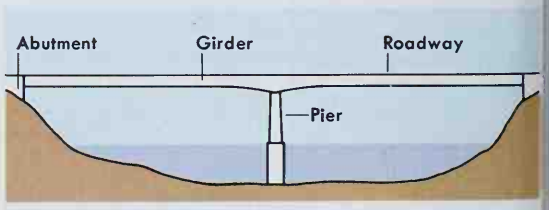
A *pontoon bridge* has no piers or abutments. It is supported by *pontoons* (flat-bottomed boats) or other portable floats. See **Pontoon bridge.**

Kinds of bridges

There are seven main kinds of bridges: (1) girder bridges, (2) truss bridges, (3) arch bridges, (4) cantilever bridges, (5) suspension bridges, (6) cable-stayed bridges, and (7) moveable bridges.

The types of bridges vary in total length, the length of their spans, and the weight they can support. Before deciding which kind to build at a particular place, engineers determine the length of the structure and of each span. They also must consider the maximum load that the bridge will carry and the materials available to construct the bridge.

Girder bridges, which include many highway bridges, are made of beams called *girders* whose ends simply rest on piers or abutments. These bridges may be used to cross most areas. The span length of girder



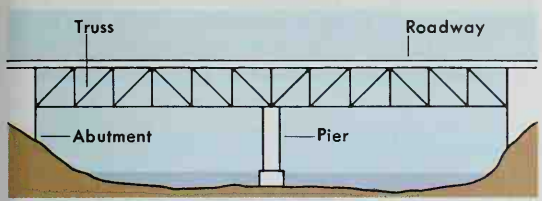
Girder bridge

Fred F. Videon, the contributor of this article, is Senior Structural Engineer at HKM Associates Engineers Planners. The diagrams in the article were prepared for World Book *by Richard Fickle.*

bridges ranges up to about 1,000 feet (300 meters).

There are two main types of girder bridges. In one type, called a *box girder bridge,* each girder looks like a long box that lies between the piers or abutments. The top surface of the bridge is the roadway. Box girder bridges are built of steel or concrete. In the other type of girder bridge, the end view of each girder looks like an *I* or a *T.* Two or more girders support the roadway. This type of bridge is called a *plate girder bridge* when made of steel, a *reinforced* or *prestressed concrete girder bridge* when made of concrete, and a *wood girder bridge* when made of wood.

Truss bridges are supported by frameworks called *trusses.* The parts of the trusses are arranged in the form of triangles. Such bridges are built over canyons, rivers, and other areas. A truss bridge may have a main span that extends more than 1,000 feet (300 meters).



Truss bridge

Each truss consists of steel or wood parts that are connected to form one or more triangles. The simplest truss consists of three parts fastened together at their ends to form a triangle.

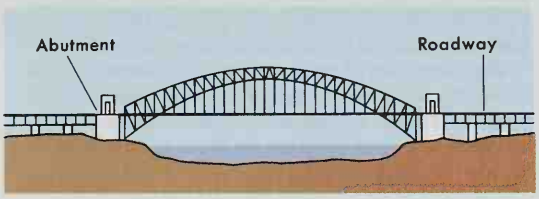
Most truss bridges have one set of trusses on each side of the roadway. The majority of modern truss bridges have the roadway on top of the trusses and are called *deck truss bridges.* The roadway of a *through truss bridge* runs between the trusses.

In a *simple span truss bridge,* each truss extends between two abutments or piers. In a *continuous truss bridge,* each truss has three or more such supports.

Some locations are suitable for either a truss bridge or a girder bridge. In such cases, some engineers choose to build a truss bridge because it requires less construction material than the girder type. However, many engineers prefer a girder bridge because it is more attractive and easier to construct and maintain.

Arch bridges are structures in which each span forms an arch. The spans range up to about 1,700 feet (518 meters) long. The arch bridge is one of the oldest types of bridges. Early arch bridges consisted of large stone blocks wedged together to form an arch. Today, the majority of arch bridges that have short spans are made of concrete or wood. Arch bridges with long spans are built of concrete or steel.

Engineers must design arch bridges so that the sides of the arch do not spread apart and collapse the bridge. The roadway of some arch bridges lies on top of the arch and is supported by vertical columns called *spandrel columns.* These columns transfer the load of the roadway to the arch, which bears the weight of the bridge. The roadway of a *tied arch bridge* is below the curve of the arch. The roadway is supported by girders or other types of beams that hang from the arch. The girders or beams also connect to the ends of the arch to prevent the ends from spreading out. The abutments support the weight of the bridge.



Steel arch bridge

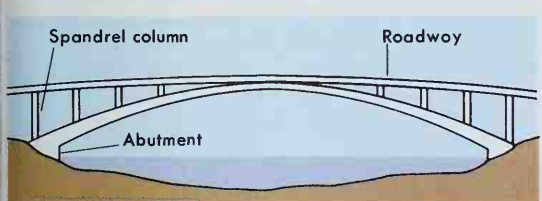
Cantilever bridges consist of two independent beams called *cantilevers* that extend from opposite banks of a waterway. The two cantilevers are joined together above the middle of the waterway by a beam, girder, or truss. Cantilever bridges may have spans as long as about 1,800 feet (549 meters).

Each cantilever has two sections, an *anchor arm* and a *cantilever arm.* The anchor arm extends between an abutment and a pier. One end of the cantilever arm is supported by the pier, and the other end extends freely over the waterway. The free ends of the two cantilevers are joined together by a *suspended span.*

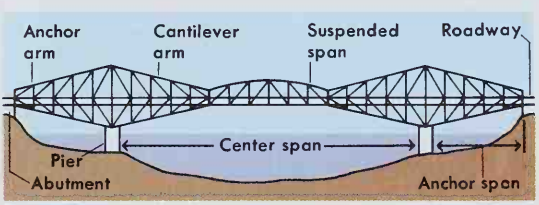
Most cantilever bridges have two *anchor spans* and one *center span.* Each anchor span consists of an anchor arm. The suspended span and the two cantilever arms make up the center span.

Many cantilever bridges have truss frameworks. Most bridges of the cantilever type are made of steel or prestressed concrete (see **Cement and concrete** [Prestressed concrete]).

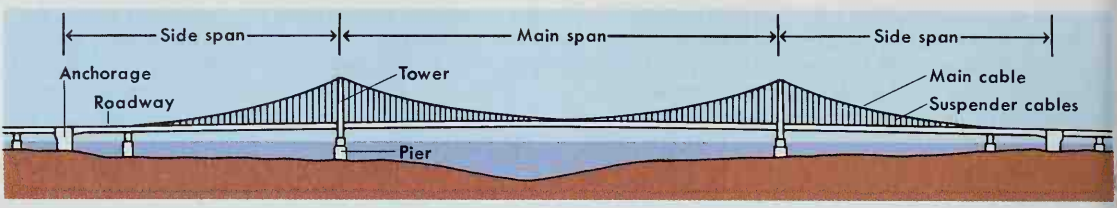
Suspension bridges are perhaps the most impressive type of bridge because of their long main span and especially attractive appearance. These bridges have a roadway that hangs from steel cables that are supported by two high towers.



Concrete arch bridge



Cantilever bridge



Suspension bridge

Suspension bridges are used to span great distances. Most suspension bridges have a main span more than 1,000 feet (300 meters) long. Some have a main span longer than 4,000 feet (1,200 meters). Suspension bridges also are used to cross deep water or steep canyons, and in other places where the construction of piers is especially difficult and expensive. These bridges require only two piers, each of which supports a tower.

The main span of a suspension bridge stretches between the two towers. Each of two *side spans* extends between a tower and an *anchorage.* Most anchorages are huge blocks of concrete set at the ends of the bridge.

The cables that are supported by the towers are called the *main cables.* A suspension bridge has at least two main cables. Each of these cables extends from one end of the bridge to the other and is secured at each end by an anchorage. The main cables are connected to the top end of vertical *suspender cables.* The bottom end of each suspender cable attaches to the roadway of the bridge.

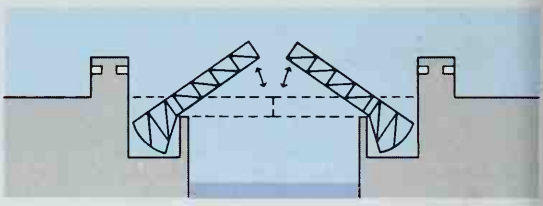
A suspension bridge may sway in a strong wind. To minimize such movement, most suspension bridges have a thick structure that supports the roadway. This type of structure helps stiffen the bridge and is called a *stiffening girder* or *stiffening truss.*

Cable-stayed bridges resemble suspension bridges. Both have roadways that hang from cables, and both have towers. In a cable-stayed bridge, however, the cables that support the roadway are connected directly to the towers.

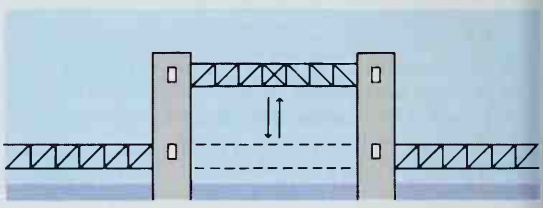
A cable-stayed bridge may be used if its foundation can support only one tower. Most cable-stayed bridges have three spans, but some have one tower and two spans. The most efficient cable-stayed bridges have a main span about 700 feet (210 meters) long.

The cables of a cable-stayed bridge may be linked from the roadway to the towers in several ways. The cables may extend from various points on the roadway to the tops of the towers, forming a *radiating pattern.* The cables form a *fan pattern,* also called a *harp pattern,* if they are connected from a variety of points on the roadway to several points on the towers. If the cables are attached from one point on the roadway to various points on the towers, they form a *star pattern.*

Moveable bridges have a roadway that is moved entirely or partially to provide enough clearance for large ships to pass. There are three types of moveable bridges, *bascule bridges, vertical lift bridges,* and *swing bridges.* A bascule bridge tilts upward to open. Some bascule bridges open at one end, and others open in the middle. A vertical lift bridge has a roadway that extends between two towers. The roadway rises between the towers, and ships pass underneath. A swing bridge is mounted on a central pier. The bridge swings sideways to enable ships to pass.



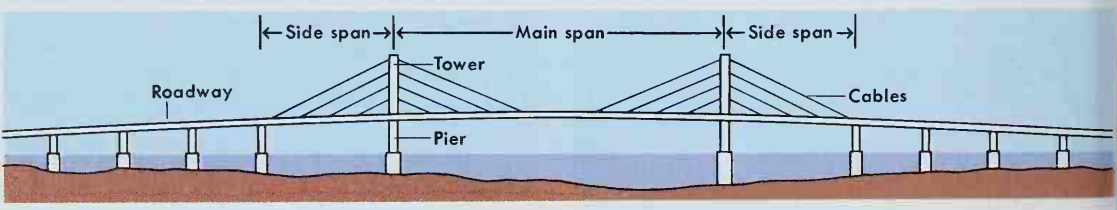
Bascule bridge



Vertical lift bridge

History

Logs or vines that extended across streams probably served as the first bridges. The first bridge known to



Cable-stayed bridge (fan, or harp, pattern)

Notable bridges

Name	Location	Main span length In feet	Main span length In meters	Total length (bridge and approaches) In feet	Total length (bridge and approaches) In meters	Year opened
Suspension						
Akashi Kaikyo	Akashi Strait, Akashi-Awaji, Japan	6,529	1,990	12,828	3,910	1998
Storebaelt	Great Belt (strait), Nyborg-Korsør, Denmark	5,328	1,624	22,277	6,790	1998
Humber	River Humber, near Hull, England	4,626	1,410	7,283	2,220	1981
Tsing Ma	Ma Wan Channel, Tsing Yi-Ma Wan, China	4,518	1,377	6,667	2,032	1997
Verrazano-Narrows	The Narrows, Brooklyn-Staten Island, New York, New York	4,260	1,298	13,700	4,176	1964
Golden Gate	Golden Gate Strait, San Francisco-Marin County, California	4,200	1,280	8,981	2,737	1937
High Coast	Ångerman River, Vasternorrland, Sweden	3,970	1,210	5,906	1,800	1998
Mackinac	Straits of Mackinac, St. Ignace-Mackinaw City, Michigan	3,800	1,158	18,615	5,674	1957
Minami Bisan-seto	Inland Sea, near Marugame, Japan	3,609	1,100	5,653	1,723	1988
Second Bosporus	Bosporus (strait), Turkey	3,576	1,090	4,954	1,510	1988
First Bosporus	Bosporus (strait), Turkey	3,524	1,074	5,118	1,560	1973
George Washington	Hudson River, New York, New York-Fort Lee, New Jersey	3,500	1,067	4,760	1,451	1931
Brooklyn	East River, Brooklyn-Manhattan, New York, New York	1,595	486	5,989	1,825	1883
Cantilever						
Quebec	St. Lawrence River, Quebec City-Lévis, Quebec	1,800	549	3,238	987	1917
Forth	Firth of Forth, near Edinburgh, Scotland	1,710	521	7,810	2,380	1890
Osaka Port	Osaka Bay, Japan	1,673	510	10,827	3,300	1974
Commodore John Barry	Delaware River, Chester, Pennsylvania-Bridgeport, New Jersey	1,644	501	13,915	4,241	1974
Greater New Orleans	Mississippi River, New Orleans, Louisiana	1,575	480	13,428	4,093	1958
Haora	Hooghly River, Kolkata-Haora, India	1,500	457	2,150	655	1943
Steel arch						
New River Gorge	New River, near Fayetteville, West Virginia	1,700	518	3,031	924	1977
Bayonne	Kill Van Kull, Bayonne, New Jersey-Staten Island, New York	1,675	511	8,460	2,579	1931
Sydney Harbour	Sydney-North Sydney, Australia	1,650	503	3,770	1,149	1932
Fremont	Willamette River, Portland, Oregon	1,255	383	8,063	2,458	1973
Zdákov	Vltava River, near Pisek, Czech Republic	1,244	380	1,782	543	1967
Port Mann	Fraser River, near Vancouver, British Columbia	1,200	366	6,870	2,094	1964
Cable-stayed						
Tatara	Inland Sea, Ehime prefecture, Japan	2,920	890	4,856	1,480	1999
Normandy	Le Havre, France	2,808	856	7,024	2,141	1994
Yangpu	Huangpu River, Shanghai, China	1,975	602	25,112	7,654	1993
Meiko Central	Ise Bay, Aichi prefecture, Japan	1,936	590	3,839	1,170	1998
Xupu	Huangpu River, Shanghai, China	1,936	590	3,261	994	1997
Skarnsundet	near Trondheim, Norway	1,739	530	3,314	1,010	1991
Tsurumi Tsubasa	Tsurumi Channel, Yokohama, Japan	1,673	510	3,346	1,020	1995
Öresund Fixed Link	Strait between Copenhagen, Denmark, and Malmö, Sweden	1,608	490	25,735	7,844	2000
Continuous truss						
Mark Clark Expressway	Cooper River, Charleston, South Carolina	1,600	488	16,450	5,014	1992
Astoria	Columbia River, Astoria, Ore.-Megler, Washington	1,232	376	21,697	6,613	1966
Concrete arch						
Krk	Adriatic Sea, Krk Island, Croatia	1,280	390	2,488	758	1979
Gladesville	Parramatta River, Sydney, Australia	1,000	305	1,900	579	1964
Plate and box girder						
Rio-Niterói	Guanabara Bay, Rio de Janeiro-Niterói, Brazil	984	300	45,604	13,900	1972
Sava I	Sava River, Belgrade, Yugoslavia	856	261	1,348	411	1956
Combination						
Lake Pontchartrain Causeway (twin causeways)	New Orleans-Mandeville, Louisiana			154,387	47,057	1956 & 1969
Chesapeake Bay Bridge-Tunnel	Cape Henry-Cape Charles, Virginia			93,192	28,405	1964
San Francisco-Oakland	San Francisco Bay, California	2,310	704	43,416	13,233	1936

Sources: Construction and engineering firms; government officials.

historians was an arch bridge built in Babylon about 2200 B.C. The ancient Chinese, Egyptians, Greeks, and Romans also built arch bridges, using bricks and stone.

During the Middle Ages, movable bridges called drawbridges were built over the moats of many castles in Europe. Truss bridges were developed in the 1500's. Most bridges were made of stone or wood until the late 1700's, when cast iron and wrought iron came into wide use. Many suspension bridges that hung from wrought iron chains were built in the early 1800's. The first plate girder bridge was finished in 1847. The modern cantilever bridge was introduced about 1870. In the late 1800's, steel became the main material used for bridges.

The first concrete bridge was built in 1869. A short time later, bridge builders began using reinforced concrete. In the 1930's, prestressed concrete became an important material for bridge building. The modern cable-stayed bridge was introduced in 1955. Fred F. Videon

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Brooklyn Bridge
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Cantilever
Engineering
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London Bridge
Mackinac, Straits of
Peace Bridge
Royal Gorge
San Francisco-Oakland Bay Bridge
Triborough Bridge
Viaduct

Bridge is a popular card game played by four persons who form two teams of two partners each. Many people in numerous countries enjoy bridge. Some players enter highly competitive tournaments.

Bridge is sometimes called *contract bridge.* The game has two main parts, *bidding* and *play.* In bidding, the players compete to name the *contract,* which includes the number of tricks in excess of six a team proposes to win. In play, the team that has won the bid tries to fulfill its contract, and the opposing team attempts to prevent it from doing so. Teams receive points for fulfilling their contracts or penalties for failing to do so.

There are two chief types of bridge—*rubber bridge* and *duplicate bridge.* Rubber bridge is the most common kind. In this form of bridge, the two teams bid and play until one wins two games. The first team to win two games wins the *rubber.* Each team then adds its points, and the team with the most points wins. Duplicate bridge is played in the majority of tournaments. In duplicate bridge, the various teams play the same series of deals. A team wins a tournament by playing its hands more skillfully—and thus scoring more points—than the other teams. An older form of bridge, called *auction bridge,* is occasionally played today. It closely resembles a simple form of contract bridge.

Rubber bridge

The deal. Rubber bridge is played with a standard deck of 52 cards. Partners sit across from each other at a table. The dealer passes one card at a time to each player until the entire deck has been distributed. Each player receives 13 cards.

After the deal is completed, the players separate their cards into suits and put them in order by rank. The rank of the cards, from highest to lowest, is ace, king, queen, jack, 10, 9, 8, 7, 6, 5, 4, 3, and 2.

Evaluating the hand. The players must estimate the value of their cards to determine their bid. The most popular method of evaluating a hand is by *point count.* Using this system, a player assigns points for high cards and for certain card distributions. The player adds 4 points for each ace, 3 for each king, 2 for each queen, and 1 for each jack. He or she assigns 3 points for a *void* (no cards of a suit), 2 for a *singleton* (1 card of a suit), and 1 for a *doubleton* (2 cards of a suit).

A player seldom opens the bidding with less than 12 points in a hand. But the value of a hand may change during the bidding. For example, a hand may have added value if it includes several cards in the suit one's partner is bidding. Experienced bridge players have elaborate bidding strategies based on point count.

Bidding is also called the auction. In bidding, partners exchange information about the playing strength of their hands. This exchange helps them in trying to name the best contract.

A bid consists of two words, a *number* and a *denomination.* The number indicates how many *odd tricks* (tricks in excess of six) the bidder proposes to win. The denomination is the suit the bidder wants to name trump. The bidder may give the denomination *no-trump* if he or she wants to play the hand without a trump suit. A bid of two spades, for example, means the player proposes to win eight tricks with spades as the trump suit. A bid of three no-trump is an offer to win nine tricks without a trump suit. A *grand slam* is the highest possible bid. It commits the bidder to taking all 13 tricks. A *small slam* is a bid to take 12 tricks.

The dealer starts the bidding and is followed by the other players in clockwise order around the table. Each player may bid or *pass*—that is, choose not to bid. Players who pass may bid at their next turn. Each bid must be higher in value than the previous one. In bidding, the denominations are ranked. Their ranks, from highest to lowest, are no-trump, spades, hearts, diamonds, and clubs. Thus, a bid of three spades is higher than a bid of three hearts. But a higher number outranks a higher denomination. Thus, a bid of two clubs is higher than one no-trump.

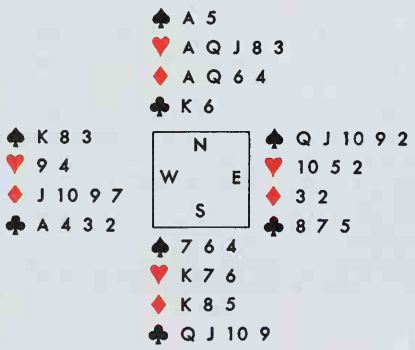
A player may *double* if he or she believes the opposing team cannot make its bid. Doubling increases the penalty against the team that won the bid if it *goes down* (fails to fulfill its contract). But doubling also raises the score of the team if it makes its bid. If an opponent has doubled, a player may *redouble* if he or she feels confident of making the bid. Redoubling further increases the penalty and the scoring of points.

Bidding continues until three players in a row pass, or all four pass during the first round of bidding. If there is no bid, the players go on to the next hand. The last bid becomes the contract. On the team that won the bid, the player who first named the denomination of the contract is called the *declarer.* The declarer may or may not be the one who made the last bid.

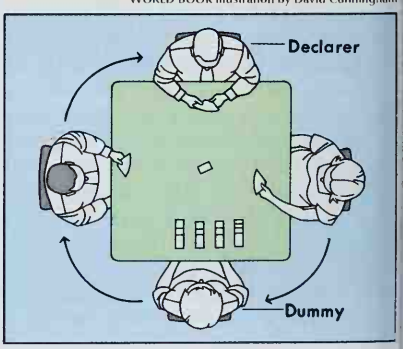
The play. The player to the left of the declarer leads the first card. The declarer's partner, called the *dummy,* then lays his or her cards face up. The play proceeds around the table in clockwise direction. The declarer plays the dummy's cards in turn. A player must *follow*

Playing bridge

After each deal, players separate their cards into suits, *right.* Players may be identified by the positions North (N), East (E), South (S), and West (W). Play begins, *far right,* after the bidding ends. The *declarer* attempts to make the *contract,* the number of tricks his or her team proposes to win. The declarer's partner is called the *dummy.* The dummy's cards are placed face up on the table and played by the declarer.



WORLD BOOK illustration by David Cunningham



suit—that is, play a card of the same suit as that of the lead card. A player who has no card in that suit may play a card of any suit. The highest card in the suit led wins the trick, unless someone plays a card from the trump suit. Then, the highest trump wins the trick. The player who wins the trick leads next. Play continues until all 13 tricks have been taken.

Scoring. A team scores points if it fulfills its contract. The first six tricks it takes are called the *book.* Each trick over six scores a certain number of points. The total of these points is called the *trick score.* A team wins a game when it has a trick score of 100 or more points. Trick scores of less than 100 points, called *part-scores,* are forwarded from one deal to another until a team wins a game.

A team may gain extra points, called a *premium score,* in several ways. For example, the declarer's team receives a premium score for each trick it takes in excess of the contract. These are called *overtricks.* A team that has won one game is *vulnerable,* which means that it may receive more points and penalties in certain cases. Premium scores do not count toward a game. The table *Bridge scoring* in this article lists all the points and penalties that can be scored.

Duplicate bridge

In duplicate bridge, all the cards are predealt. The board indicates whether or not each pair is vulnerable. The contestants lay each card that they play in a pile in front of them on the table. After all the cards have been played, the hands are placed in a tray called the *duplicate board.* Other contestants later play the same hands. Duplicate bridge directly compares the skill of different teams.

The two most common forms of duplicate bridge are *pairs play* and *team play.* In pairs play, two persons enter a tournament as partners. The pair plays the same series of hands as a number of other pairs. Partners receive *match points* for scoring more points than other pairs. After all the deals have been played, the pair with the most match points wins the tournament. In team play, people compete in teams of four players. The four players form two partnerships that play at different tables. The partnership at one table plays the same series of hands as the opponents at the other table. The team that scores the most points wins the tournament.

Regulation of tournaments

The World Bridge Federation (WBF) governs international bridge tournaments. The WBF holds world team championships each year and world pairs championships every four years. About 60 national bridge associations belong to the WBF.

The American Contract Bridge League (ACBL) is the official WBF member organization in the United States. It awards *master points* for high finishes in local, regional, or national tournaments. Players receive ratings based on their total number of points. The lowest rating is Junior Master and the highest is Grand Life Master.

History

Bridge developed from various card games that were played in England during the 1500's. These games led to the creation of *whist,* the direct forerunner of bridge. In whist, the suit of the last card dealt becomes trump, and the players do not bid. The rules of whist were first described in *A Short Treatise on the Game of Whist* (1742), by an English lawyer named Edmond Hoyle.

Bridge terms

Above the line refers to points that are not scored for tricks bid and won. These points are recorded above a horizontal line on the scoresheet and do not count toward a game.
Below the line refers to points scored for tricks bid and won. They are recorded below a horizontal line on the scoresheet and count toward a game.
Board, also called the *dummy,* is the declarer's partner. The word *board* also refers to the dummy's cards.
Opener is the player who makes the first bid.
Overcall is the bid that follows an opponent's bid.
Revoke means to play a card of another suit while holding a card of the suit that was led. It results in a penalty.
Set is the failure to make a contract.

Bridge scoring

Trick score

Points per trick bid and won

Trump	Undoubled	Doubled*
Clubs or diamonds	20	40
Hearts or spades	30	60
No-trump (first trick)	40	80
No-trump (each additional trick)	30	60

Premium score

Overtricks

	Not vulnerable doubled*	Vulnerable doubled*
Each extra trick	100	200

When undoubled, the trick score table applies for overtricks.

Slams

	Not vulnerable	Vulnerable
Small slam	500	750
Grand slam	1,000	1,500

Honors‡

No-trump	Four aces in one hand	150
Trump suit	Four honors in one hand	100
Trump suit	Five honors in one hand	150

‡Honors are not scored in duplicate bridge.

Other premium scores (rubber bridge)	
Winning rubber if opponents are not vulnerable	700
Winning rubber if opponents are vulnerable	500
Winning one game in an unfinished rubber	300
Having the only part-score in an unfinished rubber	50
Making a doubled or redoubled contract	50

Other premium scores (duplicate bridge)	
Winning game (vulnerable)	500
Winning game (not vulnerable)	300
Part-score	50
Making a doubled contract	50
Making a redoubled contract	100

Undertrick penalties

	Not vulnerable		Vulnerable	
	Undoubled	Doubled*	Undoubled	Doubled*
First undertrick	50	100	100	200
Each additional undertrick	50	200§	100	300

§In duplicate bridge, 300 for each undertrick after the third.

*Multiply by 2 if redoubled.

During the 1890's, a card game called *bridge whist* developed from whist. In bridge whist, the dealer named trump or "bridged" this right to his or her partner. In the early 1900's, *auction bridge* became popular. This game featured the auction and new scoring methods, including slams and honors. Contract bridge was created by American yachtsman Harold S. Vanderbilt and others in 1925. Jeff Rubens and Edgar Kaplan

Additional resources

Francis, Henry G., and others, eds. *The Official Encyclopedia of Bridge.* 6th ed. Am. Contract Bridge League, 2001.
Jacoby, James. *Jacoby on Bridge.* 1987. Reprint. Pocket Bks., 1989.
Stewart, Frank, and Baron, Randall. *The Bridge Book.* 4 vols. Devyn, 1988-1990.

Bridge of Sighs is a beautiful bridge in Venice, Italy. It crosses the canal between the Doges' Palace and the state prison. The structure is called the Bridge of Sighs because of the unhappy prisoners who had to cross it long ago. These prisoners were taken from the prison to the palace for trial through a passageway on the bridge.

Kurt Scholz, Shostal

The Bridge of Sighs is a famous landmark in Venice.

If the prisoners were found guilty, they were sent to execution through another passageway of the bridge.

Italian architect Antonio Contino designed the bridge. It was completed about 1600. Lord Byron referred to it in his poem *Childe Harold's Pilgrimage.*

A covered passageway between the Tombs prison and the former criminal courts building in New York City was also called the "Bridge of Sighs." It was built so that prisoners could be taken to the courtrooms without having to face pedestrians. David I. Kertzer

Bridgeport, Connecticut (pop. 139,529; met. area pop. 459,479), is the largest city in Connecticut and a major industrial and commercial center. It lies in southwestern Connecticut on the shore of Long Island Sound, an arm of the Atlantic Ocean (see **Connecticut** [political map]).

The production of machine tools ranks as Bridgeport's chief industry. The city also produces medical products and electrical equipment. Bridgeport is a center for defense industries and a major banking center. The Pequonnock River flows through the city and helps form a port for oceangoing ships.

Seaside Park extends for 2 miles (3.2 kilometers) along

Craig Vollmer, Bridgeport Marketing Partnership

Bridgeport, the largest city in Connecticut, is a commercial and industrial center of New England. The city lies along the shore of Long Island Sound in southwestern Connecticut.

the Bridgeport shoreline. The park includes a statue of the founder of the Barnum and Bailey Circus and a former Bridgeport mayor, Phineas T. Barnum, who helped build the city. Bridgeport holds an annual Barnum Festival in the last week in June and the first week in July.

The city is the home of the Bridgeport Symphony Orchestra; the Connecticut Grand Opera; the Beardsley Zoological Gardens; the P. T. Barnum Museum; and the Museum of Art, Science, and Industry. Universities and colleges in the Bridgeport area include the University of Bridgeport, Sacred Heart University, Bridgeport Engineering Institute, and Housatonic Community College.

In 1639, English colonists settled in what is now the Bridgeport area after buying the land from the Pequonnock Indians. The city was first called Stratfield and, later, Newfield. Its name was changed to Bridgeport after a bridge was built over the Pequonnock River in 1800. During the early 1800's, the city was a shipping and shipbuilding center. Bridgeport became a town in 1821 and a city in 1836. The coming of the railroads in the mid-1800's brought new industries to the community.

In the 1970's and 1980's, the city completed several urban renewal projects. Downtown development included the construction of a bank, a hotel, and the Bridgeport Center office building. The Harbor Yard sports complex includes a stadium completed in 1998 and an arena that opened in 2001. Bridgeport has a mayor-council form of government. Stephen Fagin

For the monthly weather, see **Connecticut** (Climate).

Bridger, Jim (1804-1881), a hunter, trapper, fur trader, and guide, was one of the greatest American frontiersmen. While searching for furs in the Rocky Mountains in 1824, Bridger became probably the first white person ever to see the Great Salt Lake. He took part in an early expedition that crossed the South Pass of the Rocky Mountains, and he was one of the first white people to see the wonders of the area that became Yellowstone National Park.

In 1843, when the fur trade declined, he built Fort Bridger in southwest Wyoming as a way station to supply immigrants on the Oregon Trail. During his 40 years in the mountains, Bridger married three American Indian women, none of whom survived him.

Bridger's vast geographical knowledge proved valu-

Kansas State Historical Society

Jim Bridger scouted on the Western frontier for the United States government and helped map the historic Oregon Trail.

able when the overland stage routes were planned. He climaxed a useful career by scouting for exploring parties and for army expeditions against the Indians.

Bridger strongly opposed the Mormons and eagerly guided United States troops into Utah during a conflict that has been called the Utah War or Mormon War (1857-1858). He guided the Powder River expedition of 1865, and became the first person to measure the Bozeman Trail, about 600 miles (970 kilometers) from Fort Laramie, Wyo., to Virginia City, Mont. James Bridger was born in Richmond, Va., the son of an innkeeper. He died near Kansas City. William E. Foley

Bridges, Harry (1901-1990), served as president of the International Longshoremen's and Warehousemen's Union (ILWU) from 1938 to 1977. He came to the United States in 1920 as a seaman and joined the International Longshoremen's Association (ILA). In 1934, he led a West Coast maritime strike which became a general strike. In 1937, he brought his ILA group into the Committee for Industrial Organization, a forerunner of the Congress of Industrial Organizations (CIO). Later, the CIO expelled the ILWU on grounds of Communist domination. Bridges never denied his sympathy for Communism, but he denied that he was a member of the Communist Party. The government tried unsuccessfully several times to revoke his citizenship and deport him. In 1960, he negotiated one of the first labor agreements containing provisions on automation. He was born Alfred Renton Bridges in Melbourne, Australia. Jack Barbash

Bridget, Saint, is the name of two saints of the Roman Catholic Church. The first is a patron saint of Ireland, commonly known as Saint Bride (451?-523?). According to tradition, she was a woman of great beauty and ability. Not wishing to marry or to be troubled with suitors, she prayed to become ugly. Her prayer was answered, and she went to live as a nun under a large oak. The monastery of Kildare was founded in that spot. The name means *the Church of the Oak.* Her feast day is celebrated on February 1, the supposed day of her death.

Another Saint Bridget (1303?-1373?), sometimes called *Birgitta,* or *Brigitta,* lived in Sweden, and was the best-known saint of the northern kingdoms. She had eight children, one of whom was afterwards honored as Saint Catherine of Sweden. Bridget founded the Order of Brigittines at Vadstena, Sweden, in 1346. Her feast day is celebrated on October 8. William J. Courtenay

Bridgetown (pop. 6,720) is the capital and largest city of Barbados. It lies on Carlisle Bay in southwestern Barbados (see **Barbados** [political map]). Bridgetown is the country's chief port. Its main economic activities are tourism, fishing, wholesale and retail trade, and light manufacturing and processing. The chief products include electronic components, clothing and textiles, processed sugar, molasses, and rum. Bridgetown has a branch of the University of the West Indies.

Charles Wolverstone of England founded Bridgetown in 1628. A bridge built by Indians existed on the site of the city at that time. Thus, the city was first called Indian Bridge or Indian-Bridge Town. Gustavo A. Antonini

See also **Barbados** (picture).

Bridgman, Laura Dewey (1829-1889), was the first deaf and blind child to be successfully educated in the United States. Her achievement paved the way for the education of Helen Keller and other deaf-blind youths (see **Keller, Helen A.**).

Laura was born in Hanover, N.H. She lost her hearing and sight as a result of scarlet fever when she was about 2 years old. About six years later, Laura became the pupil of Samuel Gridley Howe, a doctor who headed the New England Institution for the Education of the Blind (now Perkins School for the Blind). Howe taught Laura the names of common objects by having her feel the names in raised letters pasted on the objects.

Laura later learned finger arrangements that represented the letters of the alphabet. She never learned to speak, and communicated mostly by finger-spelling and by having words spelled into her hand. She spent most of her life helping the teachers and housekeepers at the institution. Jerome D. Schein

Bridgman, Percy Williams (1882-1961), an American physicist and philosopher of science, won the 1946 Nobel Prize in physics for his experiments on high-pressure phenomena. He put various materials under extremely high pressure, then studied their mechanical, electrical, and *thermal* (heat energy) properties. Earlier equipment produced pressures of up to 3,000 *atmospheres.* Equipment redesigned by Bridgman reached 20,000 atmospheres from about 1910 to 1930, and later approached 400,000 atmospheres. One atmosphere equals 14.7 pounds per square inch (101 kilopascals).

Bridgman's philosophy promoted an *operational* view of physics. He insisted that concepts be definable in terms of actual operations.

Bridgman, born in Cambridge, Mass., earned a Ph.D. degree from Harvard University in 1908. He was on the faculty there until 1954. Albert E. Moyer

Brief, in law, is a document that is submitted to a court by a party to a civil or criminal lawsuit. It presents the party's position on one or more issues the court has been asked to decide. Another kind of brief, called a *trial brief,* is used by a lawyer in preparing and trying a case. A trial brief may include a summary of the evi-

dence and descriptions of witnesses in the trial.

Edward J. Kionka

Brier, *BRY uhr,* also known as *tree heath,* is a shrubby plant of the heath family. It grows near the Mediterranean coast in Europe.

The brier has tiny leaves and a woody stem. It bears fragrant, white, globe-shaped flowers. The brier has thick, close-grained, hard roots, which are used in making pipes for smoking tobacco. The root is strong and durable. The best roots are dead ones that have been seasoned in the ground for many years. American and British people often call blackberry and dog-rose plants "briers." The *sensitive brier,* which is not a true brier, is native to North America.

Eric Crichton, Bruce Coleman Ltd.

The brier is a plant that bears white, globe-shaped flowers. It has tiny leaves, a woody stem, and thick, hard roots.

James L. Luteyn

Scientific classification. The brier is in the heath family, Ericaceae. Its scientific name is *Erica arborea.* The sensitive brier is in the pea family, Fabaceae or Leguminosae. It is genus *Schrankia.*

See also **Heath**; **Pipe** (tobacco).

Brieux, *bree UH,* **Eugène,** *oo ZHEHN* (1858-1932), was a French playwright. He gained fame for a series of earnest, realistic plays that explore serious social problems.

Brieux's play *Blanchette* (1892) attacks French attitudes toward education. *The Red Robe* (1900) concerns corruption in the judiciary. *Damaged Goods* (1902) calls for the open discussion of the dangers of sexually transmitted disease. *Maternity* (1903) deals with abortion and supports birth control.

Brieux's plays are seldom performed today because of their excessive moralizing. But they were widely discussed in their time, both in Europe and the United States. Brieux wrote over 30 plays during his career. He was born in Paris. Malcolm Goldstein

Brig is a two-masted sailing vessel with square sails. These sails are attached to *yards* (crosspieces) that are fastened at right angles on the masts. In addition, small sails at the front and rear of the ship are attached to the main mast. During the 1700's and 1800's, brigs served as fighting ships because they were small and fast. They were also used to transport cargo. Schooners and steamships largely replaced brigs in the late 1800's. Brigs are not used today. Brig is also the name given to a ship's prison. Joseph A. Gutierrez, Jr.

The Mariners' Museum, Newport News, Va.

Swift brigs, such as the freighter *Mermaid, shown here,* were widely used for ocean travel in the 1700's and 1800's.

Brigade, *brih GAYD,* is a military unit larger than a battalion and smaller than a division. It usually has 3,000 to 4,000 soldiers. Either combat or support troops can make up a brigade. Sweden's King Gustavus Adolphus used the first brigades in the 1600's.

A United States Army brigade consists of a headquarters and two or more battalions. Two or three brigades form a division. Before World War II (1939-1945), the U.S. Army used a *square division* of four infantry regiments organized into two brigades. Robert R. Mackey

See also **Army** (The organization of armies); **Army, United States** (table: Army levels of command).

Brigham City, *BRIHG uhm* (pop. 17,411), is in northern Utah at the foot of the Wasatch mountain range. For location, see **Utah** (political map).

Brigham City's leading employer manufactures rocket motors for missiles and spacecraft. The city is also the home of a division of a steel company and a manufacturer of air bag parts for automobiles.

The 68,000-acre (27,500-hectare) Bear River Migratory Bird Refuge is located just west of Brigham City. The Golden Spike National Historic Site is 32 miles (51 kilometers) west of the city, at Promontory. The first transcontinental railroad system was completed there in 1869. Brigham City, founded in 1851, was named for the Mormon leader Brigham Young. The city has a mayor-council form of government. It is the seat of Box Elder County. Charles C. Claybaugh

Brigham Young University, *BRIHG uhm,* is a coeducational school in Provo, Utah. It is operated by the Church of Jesus Christ of Latter-day Saints (Mormon).

The university has colleges of biology and agriculture; business; education; engineering and technology; family, home, and social sciences; fine arts and communications; humanities; nursing; physical and mathematical sciences; and physical education. The university also has a graduate school, a law school, a school of management, and a sequence for religious education. The university grants bachelor's, master's, and doctor's degrees. It also has a campus in Laie, Oahu, Hawaii, which grants bachelor's degrees.

Brigham Young University was founded in 1875 by Brigham Young, a Mormon leader (see **Young, Brigham**). The school, first called Brigham Young Academy, took its present name in 1903.

Critically reviewed by Brigham Young University

Bright, Richard (1789-1858), an English physician, won recognition in 1827 when he pointed out the connection between diseased kidneys, albumin in the urine, and dropsy. This led him to define clearly the condition that became known as Bright's disease, now called *nephritis* (see **Nephritis**).

Bright was appointed to the medical staff of Guy's Hospital in 1820 and began to practice in London. He spent many hours every day studying hospital patients and examining the diseased organs after death.

Bright's two volumes of *Reports of Medical Cases* (1827-1831) contain accurate descriptions of many medical conditions, including tuberculosis of the larynx, cerebral hemorrhage, and typhoid fever. This work helped influence English physicians to conduct research in disease in the early 1800's. Bright was born in Bristol and graduated from the University of Edinburgh.

Dale C. Smith

Brighton and Hove (pop. 232,600) is a city on the southern coast of England. Its pleasant climate and location along the English Channel attract many vacationers. Brighton and Hove lies about 60 miles (97 kilometers) south of London (see **England** [political map]).

The city's most famous landmark is the Royal Pavilion. This ornate building was constructed as a home for the Prince of Wales (later King George IV) in the late 1700's and early 1800's. It is now used for concerts and social events. Antique shops, cafes, and restaurants line the narrow streets of the Lanes district near the waterfront. A marina and recreation complex are along the shore. The Seafront and the Palace Pier serve as promenades.

The University of Brighton is in the center of the city and the University of Sussex lies on the outskirts of Brighton and Hove. Brunswick Square, famed for its Regency architecture, is on the west side of the city.

Brighton began as a small fishing village. It became a fashionable health resort when British aristocrats began vacationing there in the late 1700's. In the 1800's, rail transportation made Brighton a favorite vacation spot for middle- and working-class people.

Originally, Hove was a separate village. During the 1800's, it grew into a prosperous Victorian town. Brighton and Hove became a unitary authority in 1997 and received city status in 2000. Peter J. Laugharne

Bright's disease. See Nephritis.

Brigitta, Saint. See Bridget, Saint.

Brink, Carol Ryrie (1895-1981), an American author of children's books, received the 1936 Newbery Medal for *Caddie Woodlawn*. This book grew out of stories of pioneer days in Wisconsin told by her grandmother. Her stories are filled with adventure and humorous events. Other works include *Mademoiselle Misfortune* (1936), *Magical Melons* (1944), *Family Grandstand* (1952), *Family Sabbatical* (1956), and *Two Are Better Than One* (1968); and a novel for adults, *Strangers in the Forest* (1959).

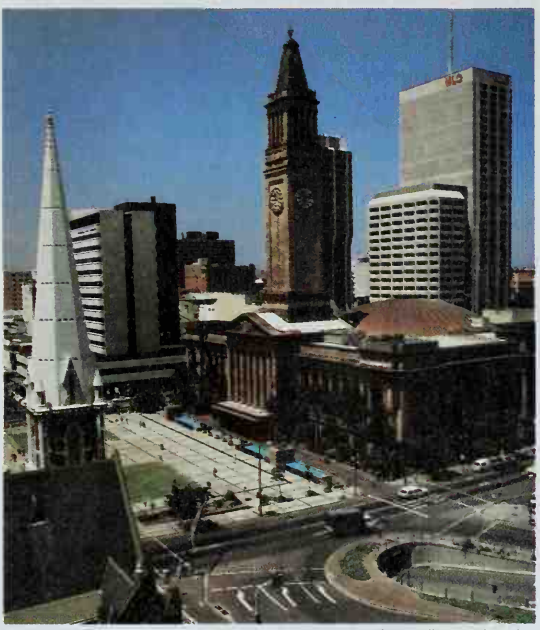
Carol Ryrie Brink was born in Moscow, Idaho. By the time she was 8 years old, both her parents had died, and she went to live with her grandmother. She attended the University of Idaho and graduated from the University of California. Virginia L. Wolf

Brisbane, *BRIHZ bayn* or *BRIHZ buhn* (pop. 1,488,883), is the capital of Queensland, a state of Australia. It is located in the southeast corner of the state. The city lies along the Brisbane River, near the Pacific Ocean (see **Australia** [political map]).

Brisbane ranks third in population among Australia's cities, after Sydney and Melbourne. It covers 376 square miles (975 square kilometers), making it one of the world's largest cities in area. Brisbane's commercial center is located along the Brisbane River, about 9 miles (15 kilometers) from the Pacific Ocean. Old industrial and residential areas also are located near the river. Since the mid-1900's, many new industrial and residential areas have been built in outlying areas of Brisbane. Expressways and railways connect the outer areas and the center of the city.

Brisbane is the main industrial and service center of Queensland. Its industrial activities include oil refining, food processing, and the production of fertilizer. A large proportion of Queensland's imports and exports pass through the port of Brisbane.

In 1823, the British explorer John Oxley became the first European to reach the area that is now Brisbane. In



© Luis Villota, Stock Market

The Brisbane City Hall was built in the classic Greek style of architecture. It stands in King George Square. Brisbane is the capital and main commercial center of the state of Queensland.

1824, Sir Thomas Brisbane, governor of New South Wales, established a prison settlement there. The city was later named for him. The convicts were removed in 1839, and the area was opened to free settlers in 1842.

Brisbane became the capital of Queensland in 1859. It grew steadily until 1893, when a flood caused widespread damage. Several dams were later built to help control floods and provide water, and Brisbane expanded steadily. Since 1940, its population has quadrupled. In 1974, another major flood damaged about 14,000 houses in the area. A world's fair was held in Brisbane in 1988. The fair was part of Australia's bicentennial celebration. An attractive park was developed on the fairground. Robin Peter Simson

Brisbane, *BRIHZ bayn,* **Arthur** (1864-1936), was one of the first syndicated newspaper columnists in the United States. He was the highest paid journalist of the early 1900's. His columns reached 30 million readers.

Brisbane joined the *New York Sun* staff when he was 19 years old, and rose to managing editor in five years. Then he became Sunday editor of Joseph Pulitzer's *New York World.* Later, as a managing editor for William Randolph Hearst, Brisbane greatly increased the circulation of the *New York Evening Journal.*

Brisbane emphasized clearly and briefly written stories and the use of bold headlines and attractive pictures. He was born in Buffalo, New York.

Joseph P. McKerns

Bristle is the term for the coarse, stiff hair used in various kinds of brushes. Some bristles are made from animal hairs, especially hair from the backs of hogs. Others are made from chemical substances such as nylon. Synthetic bristles remain stiff in boiling water and usually resist the action of chemicals better than animal bristles.

Subhash K. Batra

Bristlecone pine is an evergreen tree that grows at high altitudes in the Western United States. There are two species of bristlecone pines. One species, the *Great Basin bristlecone pine,* lives longer than any other kind of tree. These trees are found in California, Nevada, and Utah. Some Great Basin bristlecone pines are more than 4,000 years old. The oldest known living tree is a Great Basin bristlecone pine in the White Mountains of eastern California. This tree, named Methuselah, is more than 4,600 years old. The second species of bristlecone pine, the *Rocky Mountain bristlecone pine,* grows in Arizona, Colorado, and New Mexico. These trees live up to 2,000 years.

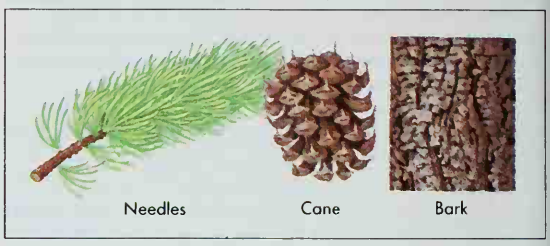
Some bristlecone pines grow as tall as 70 feet (21 meters). Others are merely twisted shrubs. Young trees have smooth, thin, light-gray bark. Old ones have grooved, thick, reddish-brown bark. The name *bristlecone* comes from the prickles on the tree's pine cones.

Bristlecone pines live an extremely long time chiefly because they grow slowly and live in cool, dry areas that have few harmful insects and diseases. Also, a bristlecone pine can survive even if all but a few of its branches and roots die. In most of the ancient trees, a thin strip of living bark connects the roots with the few live branches remaining on the tree. In addition, bristlecone pine needles remain on the tree from 15 to 30 years. The long life of the needles enables the tree to survive many successive years of drought or extreme cold, when few new needles can grow.

David Muench

The Great Basin bristlecone pine, shown above, ranks among the oldest living things. Some of these ancient trees are more than 4,000 years old. The drawings below show the needles, cone, and bark of a mature Great Basin bristlecone pine.

WORLD BOOK illustration by James Teason and Chris Smith Skilton



Because bristlecone pines live so long, they can be used to learn about past climates. A living pine tree makes a ring of new wood every year. The ring's thickness depends on the temperature and the amount of rainfall. By measuring the rings in wood from very old bristlecone pines, scientists can determine what the climate was like three or four thousand years ago.

Scientific classification. Bristlecone pines belong to the pine family, Pinaeceae. The scientific name for the Great Basin bristlecone pine is *Pinus longaeva.* The Rocky Mountain bristlecone pine is *P. aristata.* Douglas G. Sprugel

Bristol, *BRIHS tuhl* (pop. 370,300), is an industrial city and seaport in southwestern England. It lies along the River Avon about 7 miles (11 kilometers) east of the Bristol Channel, an arm of the Atlantic Ocean. For location, see **England** (political map).

Once-busy docks line parts of the Bristol waterfront. Nearby towns on the Bristol Channel now handle most of the shipping. The center of the city has old and modern buildings. Landmarks include a cathedral that dates from the 1100's; St. Mary Redcliffe, a magnificent parish church; and Bristol University. The main industries of Bristol include engineering and the production of aircraft and electronic products. The city is also an important commercial and financial center.

Roman soldiers built a settlement on the site of what is now Bristol about A.D. 100. Bristol became an important seaport in the 1000's. During the 1600's and 1700's, it was a major center for the shipment of African slaves to North America. German bombing raids during World War II (1939-1945) heavily damaged Bristol, but the damaged areas were soon rebuilt. Peter R. Mounfield

Bristol Channel is an arm of the Atlantic Ocean that lies between Wales and southwestern England. The channel extends 80 miles (130 kilometers) from the sea to the River Severn (see **United Kingdom** [terrain map]). The incoming tide sweeps up the narrowing channel, causing a *bore* (high tidal wave) that reverses the flow of the River Severn. The tide often rises as much as 40 feet (12 meters).

Swansea and Cardiff are the major ports on the Welsh shore. Bristol lies close to the head of the channel. Nearby, the River Avon flows into the mouth of the River Severn. D. Q. Bowen

Britain. See **United Kingdom; Great Britain.**

Britain, Battle of. See **World War II** (The Battle of Britain); **Churchill, Sir Winston** (The Battle of Britain).

Britannia metal is an alloy consisting of a minimum of 90 percent tin and up to 8 percent antimony and 2 percent copper. It may contain other metals. Britannia metal is used to make pewter objects such as tableware.

British America refers to those parts of North and South America that have political ties to Britain. Some are overseas territories of the United Kingdom, such as Anguilla, Bermuda, the British Virgin Islands, the Cayman Islands, the Falkland Islands, Montserrat, and the Turks and Caicos Islands. Many independent countries are also part of British America. These nations include Antigua and Barbuda, the Bahamas, Barbados, Belize, Canada, Dominica, Grenada, Guyana, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, and Trinidad and Tobago. Most of the political units of British America are members of the Commonwealth of Nations. John Edwin Coffman

British Broadcasting Corporation (BBC) broadcasts radio and television programs to audiences in the United Kingdom. It also broadcasts radio programs in English and 35 other languages to other countries in all parts of the world. The owners of television sets in the United Kingdom pay annual license fees that finance BBC programs there. Grants from the British government pay for programs that are broadcast to other countries. The BBC operates on a nonprofit basis and has no commercial advertising.

The BBC operates five radio networks for the United Kingdom. Radio 1 and Radio 2 provide continuous programs of light and popular music. Radio 3 mainly offers classical music. Radio 4 provides documentaries, news and information services, drama, and broadcasts for schools. Radio 5 is devoted to education and sports. BBC offers regional radio services in Northern Ireland, Scotland, and Wales (where one channel is broadcast in Welsh and one in English). About 40 local radio stations broadcast regional services in England. In addition, BBC Television operates two channels for the United Kingdom and provides regional programming for Northern Ireland, Scotland, Wales, and three subdivisions of England.

The British government established the BBC in 1922 as the British Broadcasting Company. In 1927, the BBC was reorganized and renamed the British Broadcasting Corporation. The BBC has complete independence in the conduct of its radio and TV services. It is a public corporation and operates under royal charter. The queen appoints 12 governors, who are independent of politics, to determine BBC's general policies. A director-general heads the BBC and is responsible for carrying out those policies. Twelve directors assist the director-general. Critically reviewed by the British Broadcasting Corporation

British Cameroons was a United Nations trust territory on the west coast of Africa. It consisted of a long, narrow strip of land between Nigeria on the west and Cameroon on the east. It extended about 700 miles (1,100 kilometers) from the Gulf of Guinea northward to the area of Lake Chad.

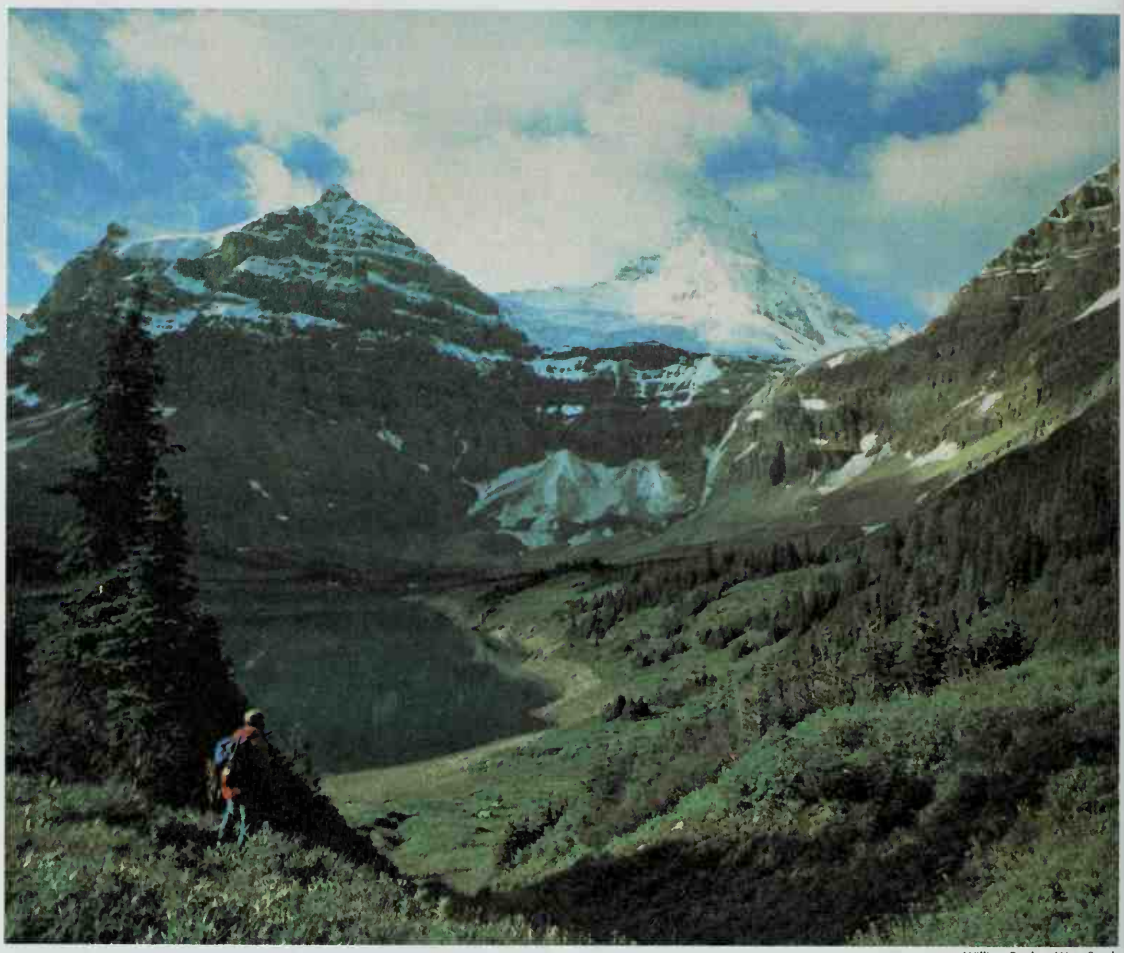
British Cameroons was a part of the German colony of Kamerun from 1884 to World War I. Germany lost its African colonies during the war, and Britain and France divided Kamerun. After World War I, they administered the territories as mandates of the League of Nations. Beginning in 1946, they governed them as trust territories of the United Nations.

The area France administered became independent as Cameroon in 1960. That same year, the United Nations authorized Britain to end its trusteeship of British Cameroons. Voters in the two sections of the trust territory were allowed to choose whether they wanted to join Nigeria or Cameroon. The northern part of British Cameroons joined Nigeria on June 1, 1961. The southern part of British Cameroons joined Cameroon on Oct. 1, 1961. Alan P. Merriam

See also **Cameroon; Nigeria.**

© BBC Enterprises

The BBC Television Centre in London produces a wide range of TV programs, including natural science films, drama, and light entertainment. The BBC operates two TV channels for the United Kingdom and offers separate programs for Scotland, Wales, Northern Ireland, and three subdivisions of England.



William Boehm, West Stock

The spectacular Rocky Mountains in Mount Assiniboine Provincial Park

British Columbia

British Columbia is Canada's third largest province. Only Quebec and Ontario are larger. The province is often referred to by its initials, "B.C." British Columbia is the only province that lies on the Pacific Ocean. It includes the Queen Charlotte Islands, 60 miles (97 kilometers) from the mainland, and Vancouver Island, 285 miles (459 kilometers) long, located on the southwestern coast.

More than half of all British Columbians live in the Vancouver-Victoria region in the southwestern corner of the province. Vancouver, British Columbia's largest city, is a port on the mainland. Victoria, on the southeastern tip of Vancouver Island, is the capital of the province. The Vancouver-Victoria region has a mild climate and fertile lowlands for farming. Ferries carry goods and passengers between Vancouver Island and the mainland.

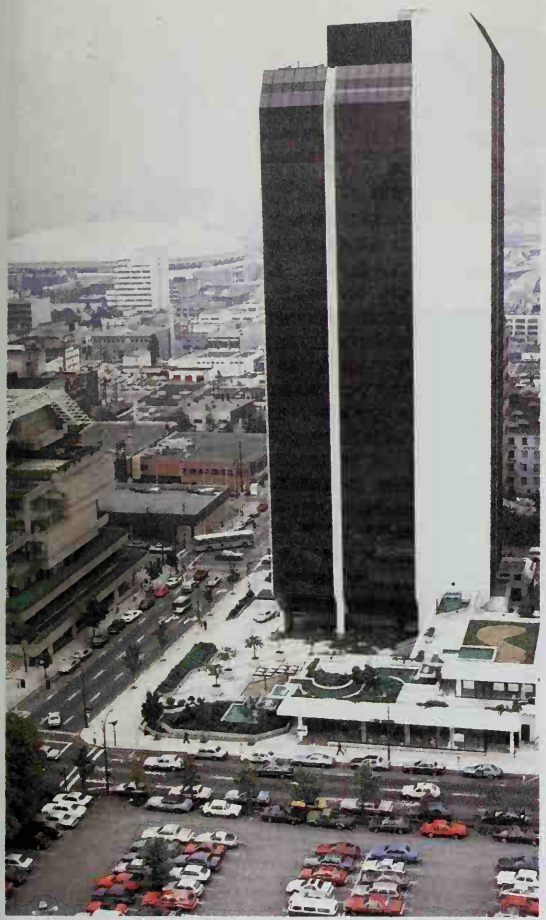
British Columbia has a larger area than California, Oregon, and Washington together. A narrow strip of Alaska separates the northern part of the province from the Pacific Ocean.

Southern British Columbia has a rugged coastline known for its natural beauty. Steep, forested mountains rise up from the shore. Narrow arms of the sea reach far inland, winding among the mountains. Islands dot the coastal waters.

The large inland area of British Columbia, usually called the *interior,* has high mountain ranges and rugged plateaus. Cold air from the Yukon Territory may bring bitterly cold winter weather, and the rugged land and severe climate make transportation and settlement difficult. But the interior of British Columbia has beautiful mountains, sparkling lakes and rivers, and abundant wildlife.

The forests of British Columbia provide about three-

The contributors of this article are Robert A. J. McDonald, Assistant Professor of History at the University of British Columbia; and Graeme Wynn, Professor of Geography at the University of British Columbia.



Artstreet

Vancouver, British Columbia's largest city

Interesting facts about British Columbia

WORLD BOOK illustration by Kevin Chadwick

Tallest totem pole

The tallest totem pole preserved in a museum, and one of the tallest ever carved, was made in British Columbia in 1870. It stands 80 feet 6 inches (24.5 meters) high and displays the symbols of two clans, the Eagle and Wolf. The totem pole was carved by a master carver named Oyai, and erected by Chief Mountain of the Eagle clan and Chief Hladerh of the Wolf clan. It is exhibited in the Royal Ontario Museum in Toronto.

Vancouver's Nine o'Clock Gun booms every evening to let citizens set their watches.

A town with the unusual name of 100 Mile House is a reminder of British Columbia's gold rush of the mid-1800's. Gold was discovered along the Fraser River in the 1850's. An English adventurer named Billy Barker then made a large strike in 1862 in the place that now bears his name, Barkerville. Thousands of prospectors headed for the area. A stagecoach traveled to the gold fields from Lillooet, which represented mile zero, and 100 Mile House was the midway mark to the gold fields. Other stops along the way became the towns of 70 Mile House and 150 Mile House.

Stanley Park, in Vancouver, is one of the largest urban parks in North America. It covers 1,000 acres (400 hectares) and includes beaches, totem poles, tennis courts, cricket and rugby fields, a lighthouse, and an aquarium.

fifths of Canada's lumber. Mines in the province yield coal, copper, gold, lead, molybdenum, sand and gravel, silver, zinc, and other minerals. Natural gas and oil are piped from fields in the northeast. British Columbia is a leading province in fishing.

British Columbia has a colorful frontier history. Gold strikes near the Fraser River in the late 1850's opened up the interior. Most of the miners left the region after the gold ran out, but settlers stayed on to farm and trap. Frontier days in British Columbia did not end in that period. Since the mid-1900's, several *resource towns,* including Kitimat, Mackenzie, and Tumbler Ridge, have been built in sparsely settled areas. These towns serve such resource-based industries as mining and logging. Roads and railroads have been built to link the northern interior of the province with the industrial southwest. Huge dams and power projects also have been constructed.

For the relationship of British Columbia to other Canadian provinces, see the articles on **Canada; Canada, Government of; Canada, History of.**

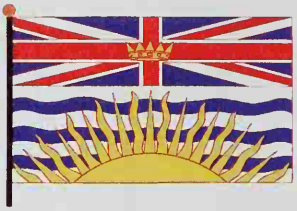
Berg & Associates

Logs entering a pulp mill in Nanaimo

British Columbia in brief

Symbols of British Columbia

The provincial flag, adopted in 1960, has a design similar to that of the shield in the coat of arms. The coat of arms was originally adopted in 1906 and was revised in 1987. Its royal lion, crown, and Union Jack all symbolize the province's link with the United Kingdom. The wavy blue bars stand for the Pacific Ocean. The setting sun represents the province's location as the most western province. The elk and sheep are animals found in the province.



Provincial flag

British Columbia (brown) ranks third in size among all the provinces in Canada.

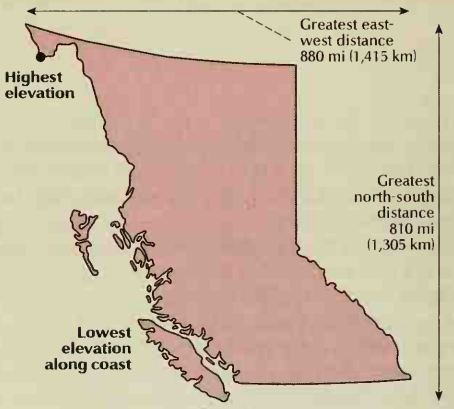
General information

Entered the Dominion: July 20, 1871, the 6th province.
Provincial abbreviation: BC (postal).
Provincial motto: *Splendor Sine Occasu* (Splendor Without Diminishment).

Parliament Buildings are in Victoria, the capital of British Columbia since it became a province in 1871.

Land and climate

Area: 365,900 mi² (947,800 km²), including 6,980 mi² (18,070 km²) of inland water.
Elevation: *Highest*—Mount Fairweather, 15,300 ft (4,663 m) above sea level. *Lowest*—sea level along the Pacific coast.
Coastline: 15,985 mi. (25,725 km).
Record high temperature: 112 °F (44 °C) at Lytton, Lillooet, and Chinook Cove on July 16 and 17, 1941.
Record low temperature: −74 °F (−59 °C) at Smith River on Jan. 31, 1947.
Average July temperature: 61 °F (16 °C).
Average January temperature: 18 °F (−8 °C).
Average yearly precipitation: 33 in (84 cm).



Important dates

1778 — British Captain James Cook landed on Vancouver Island.

1843 — The Hudson's Bay Company founded Fort Victoria.

1846 — The Oregon Treaty set the boundary between British Columbia and the United States.

1861 — The gold rush to the Cariboo District began.

Provincial coat of arms

Provincial seal

Floral emblem
Pacific dogwood

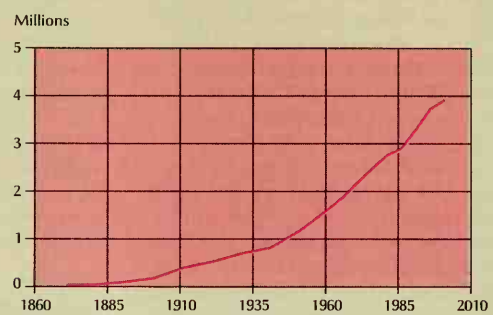
People

Population: 3,907,738 (2001 census)
Rank among the provinces: 3rd
Density: 11 persons per mi² (4 per km²), provinces average 13 per mi² (5 per km²)
Distribution: 85 percent urban, 15 percent rural
Largest cities and towns*

Vancouver	545,671
Surrey	347,825
Burnaby	193,954
Richmond	164,345
Abbotsford	115,463
Coquitlam	112,890

*2001 census.
Source: Statistics Canada.

Population trend



Source: Statistics Canada.

Year	Population
2001	3,907,738
1996	3,724,500
1991	3,282,061
1986	2,889,207
1981	2,744,467
1976	2,466,608
1971	2,184,621
1966	1,873,674
1961	1,629,082
1951	1,165,210
1941	817,861
1931	694,263
1921	524,582
1911	392,480
1901	178,657
1891	98,173
1881	49,459
1871	36,247

Economy

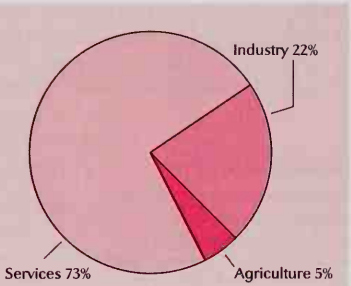
Chief products

Agriculture: nursery products, dairy products, apples, beef cattle.
Fishing industry: salmon.
Forestry: fir, pine, spruce, hemlock.
Manufacturing: wood products, paper products, food products.
Mining: coal, copper, natural gas.

Gross domestic product

Value of goods and services produced in 2000: $113,058,000,000.* *Services* include community, business, and personal services; finance; government; trade; and transportation and communication. *Industry* includes construction, manufacturing, mining, and utilities. *Agriculture* includes agriculture, fishing, and forestry.

*Canadian dollars.
Source: Statistics Canada.



Government

Provincial government

Premier: term of up to five years
Members of the Legislative Assembly: 79; terms of up to five years

Federal government

Members of the House of Commons: 32
Members of the Senate: 6

Sources of information

For information on tourism in British Columbia, write to: Tourism BC, 1803 Douglas Street, Suite 300, Box 9830, Station Provincial Government, Victoria, BC V8W 9W5. Tourism BC's Web site at www.hellobc.com also provides tourist information. The British Columbia government's Web site at www.gov.bc.ca is also a useful resource.

1871 — British Columbia became a province on July 20.

1885 — Canada's transcontinental railroad was completed at Craigellachie.

1951 — Major natural gas and oil fields were discovered near Fort St. John in the Peace River District.

1972 — The New Democratic Party became the first socialist party to form the provincial government.

Population. The 2001 Canadian census reported that British Columbia had a population of 3,907,738. The population had increased about 5 percent over the 1996 figure of 3,724,500.

Southwestern British Columbia is the most heavily populated part of the province. About half of the people of British Columbia live in the Vancouver metropolitan area. This area and the nearby Victoria and Abbotsford metropolitan areas are Census Metropolitan Areas as defined by Statistics Canada.

Vancouver, the province's largest city, lies near the mouth of the Fraser River. Vancouver is a major seaport and an important business and financial center. Many of the province's other large communities lie within the Vancouver metropolitan area. These include Burnaby, Coquitlam, Richmond, and Surrey. Victoria, the capital of British Columbia, lies on Vancouver Island. Victoria has many gardens, winding streets, and parliament buildings. Kamloops and Prince George are the largest cities north of the Vancouver area. Kelowna in the Okanagan Valley is a rapidly growing community.

About 75 percent of British Columbia's people were born in Canada. The largest groups from other countries came from the United Kingdom and the United States. About half the people have some English ancestry. Other large ethnic groups include people of Scottish, Irish, German, and French descent. About 110,000 people in British Columbia have some American Indian ancestry.

Schools. In 1849, the Hudson's Bay Company, a British trading firm, began operating a school for the children of its employees on Vancouver Island. The Public School Act of 1872 established a free provincial school system. Today, the Ministry of Education is responsible for the administration of British Columbia's public school system. The minister is a member of the Cabinet of the Legislative Assembly.

Each school district in British Columbia is administered either by an elected board of school trustees or by a trustee appointed by the province's lieutenant governor in council. Children from ages 6 through 15 must attend school. For the number of students and teachers in British Columbia, see **Education** (table).

Libraries and museums. Public libraries serve people throughout British Columbia. The University of British Columbia in Vancouver, the University of Victoria in Victoria, and Simon Fraser University in Burnaby have large academic libraries. The Legislative Library in Victoria provides reference services for the legislature and for departments of the provincial government.

The British Columbia Archives in Victoria have a fine collection on the province's history. The Royal British Columbia Museum in Victoria has exhibits on natural history, ocean life, Indian culture, and modern history. The H. R. MacMillan Space Centre in Vancouver includes a planetarium and an observatory. The Maritime Museum of British Columbia in Victoria has an outstanding collection of exhibits on maritime heritage and culture. The Vancouver Maritime Museum displays the Arctic exploring ship *St. Roch.*

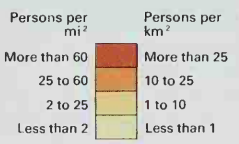
Universities and colleges

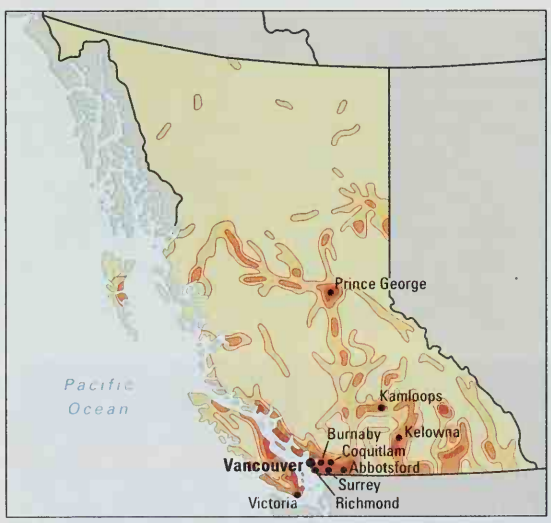
This table lists the universities and colleges in British Columbia that grant bachelor's or advanced degrees and are members of the Association of Universities and Colleges of Canada.

Name	Mailing address
British Columbia, University of	Vancouver
British Columbia Open University	Burnaby
Cariboo, University College of the	Kamloops
Emily Carr Institute of Art and Design	Vancouver
Fraser Valley, University College of the	Abbotsford
Malaspina University-College	Nanaimo
Northern British Columbia, University of	Prince George
Okanagan University College	Kelowna
Royal Roads University	Victoria
Simon Fraser University	Burnaby
Trinity Western University	Langley
Victoria, University of	Victoria

Population density

British Columbia's population is distributed unevenly because of mountainous terrain. Most of the people live in the southwest, near Vancouver.





WORLD BOOK map; based on the *National Atlas of Canada*

Cameramann International, Ltd.

The Museum of Anthropology at the University of British Columbia in Vancouver features art and artifacts relating to the Haida and other Indians of the Pacific Coast.

British Columbia map index

Metropolitan areas

Abbotsford 147,370
Vancouver 1,986,965
Victoria 311,902

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Langley .....23,643 ..C 14
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Port Coquitlam ...51,257 ..C 14
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Port McNeill .....2,821 ..I 4
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Terrace .....12,109 ..F 4
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Tintagel .....F 5
Tofino† .....1,466 ..J 5
Trail .....7,575 ..K 9
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Tzeachten Indian Reserve* .....683 ..C 16
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Winter Harbour .....I 4
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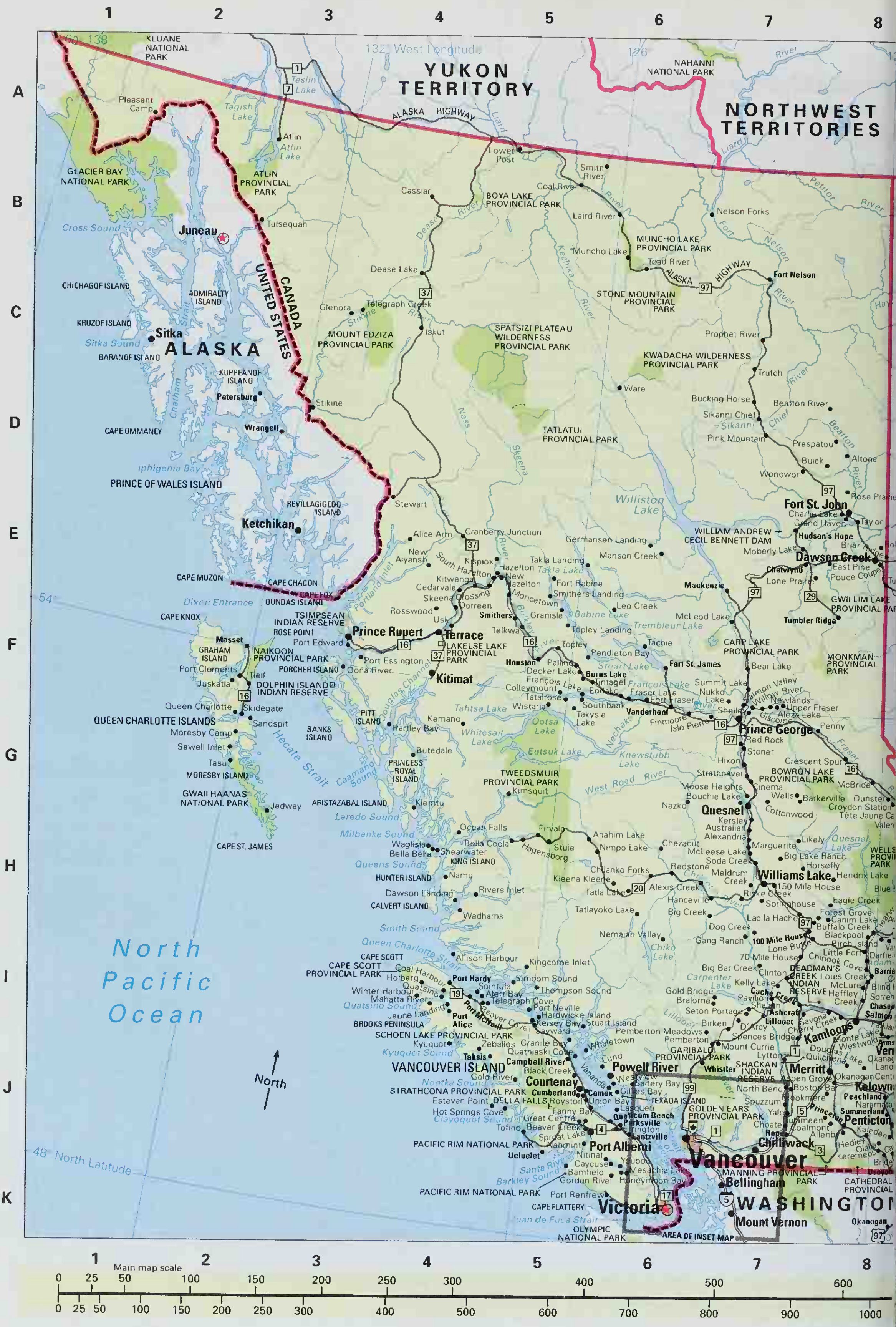
Ymir .....J 10
Youbou .....K 6
Zeballos .....224 ..J 4

*Not shown on map; key indicates general location.
†District municipality.
Source: 2001census. Places without populations are unincorporated.



KLUANE NATIONAL PARK
YUKON TERRITORY
NAHANNI NATIONAL PARK
NORTHWEST TERRITORIES
132 West Longitude
126
60 138
ALASKA HIGHWAY
Teslin Lake
Tagish Lake
Pleasant Camp
Atlin
Atlin Lake
ATLIN PROVINCIAL PARK
GLACIER BAY NATIONAL PARK
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BOYA LAKE PROVINCIAL PARK
Cassiar
Laird River
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Petitot River
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Cross Sound
MUNCHO LAKE PROVINCIAL PARK
Muncho Lake
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Fort Nelson
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STONE MOUNTAIN PROVINCIAL PARK
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ADMIRALTY ISLAND
UNITED STATES
CANADA
Glenora
Telegraph Creek
KRUZOF ISLAND
Sitka
Sitka Sound
ALASKA
BARANOF ISLAND
MOUNT EDZIZA PROVINCIAL PARK
Iskut
SPATSIZI PLATEAU WILDERNESS PROVINCIAL PARK
Prophet River
KWADACHA WILDERNESS PROVINCIAL PARK
Trutch
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Stikine
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Rose Prairie
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Ketchikan
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Taylor
Alice Arm
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Germansen Landing
WILLIAM ANDREW CECIL BENNETT DAM
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Kispiox
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Takla Lake
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CAPE CHACON
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Telkwa
Topley Landing
Trembleur Lake
Masset
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Topley
Tachie
CARP LAKE PROVINCIAL PARK
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NAIKOON PROVINCIAL PARK
Port Essington
Houston
Pendleton Bay
MONKMAN PROVINCIAL PARK
Port Clements
PORCHER ISLAND
Oona River
Kitimat
Palling
Stuart Lake
Fort St. James
Bear Lake
Tlell
Juskatla
DOLPHIN ISLAND INDIAN RESERVE
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Burns Lake
Tintagel
François Lake
Summit Lake
Salmon Valley
Colleymount
Endako
Fraser Lake
Nukko Lake
Willow River
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Chilanko Forks
Redstone
Meldrum Creek
HUNTER ISLAND
Namu
Kleena Kleene
Williams Lake
Hendrix Lake
Alexis Creek
150 Mile House
Dawson Landing
Rivers Inlet
Tatla Lake
Riske Creek
CALVERT ISLAND
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Big Creek
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Canim Lake
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Blackpool
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Lone Butte
Birch Island
Queen Charlotte Strait
Chilko Lake
70 Mile House
Little Fort
North
Pacific
Ocean
CAPE SCOTT
Allison Harbour
Kingcome Inlet
Chinook Cove
Darfield
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Coal Harbour
Port Hardy
Simoom Sound
Big Bar Creek
Clinton
DEADMAN'S CREEK INDIAN RESERVE
Louis Creek
Barriere
Holberg
Sointula
Carpenter Lake
Kelly Lake
McLure
Blind Bay
Winter Harbour
Quatsino
Alert Bay
Thompson Sound
Gold Bridge
Cache Creek
Heffley Creek
Mahatta River
Telegraph Cove
Bralorne
Pavilion
Sorrento
Quatsino Sound
Port McNeill
Port Neville
Shalalth
Chase
Jeune Landing
Beaver Cove
Hardwicke Island
Seton Portage
Ashcroft
Salmon Arm
Port Alice
Kelsey Bay
Stuart Island
Lillooet
Savona
BROOKS PENINSULA
Sayward
Birken
Cherry Creek
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Pemberton Meadows
D'Arcy
Kamloops
Kyuquot
Zeballos
Granite Bay
Pemberton
Spences Bridge
Monte Lake
Westwold
Kyuquot Sound
Quathiaski Cove
Whaletown
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Douglas Lake
Tahsis
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Lytton
Quilchena
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VANCOUVER ISLAND
Campbell River
Lund
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Union Bay
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Spuzzum
Brookmere
Naramata
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Yale
Princeton
Summerland
Clayoquot Sound
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Tofino
Beaver Creek
Parksville
Coalmont
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Lantzville
Choate
Hope
Allenby
PACIFIC RIM NATIONAL PARK
Nahmint
Port Alberni
Chilliwack
Hedley
Olalla
Ucluelet
Nitinat
Vancouver
Keremeos
Santa River
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Youbou
Bride
48 North Latitude
Barkley Sound
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OLYMPIC NATIONAL PARK
AREA OF INSET MAP
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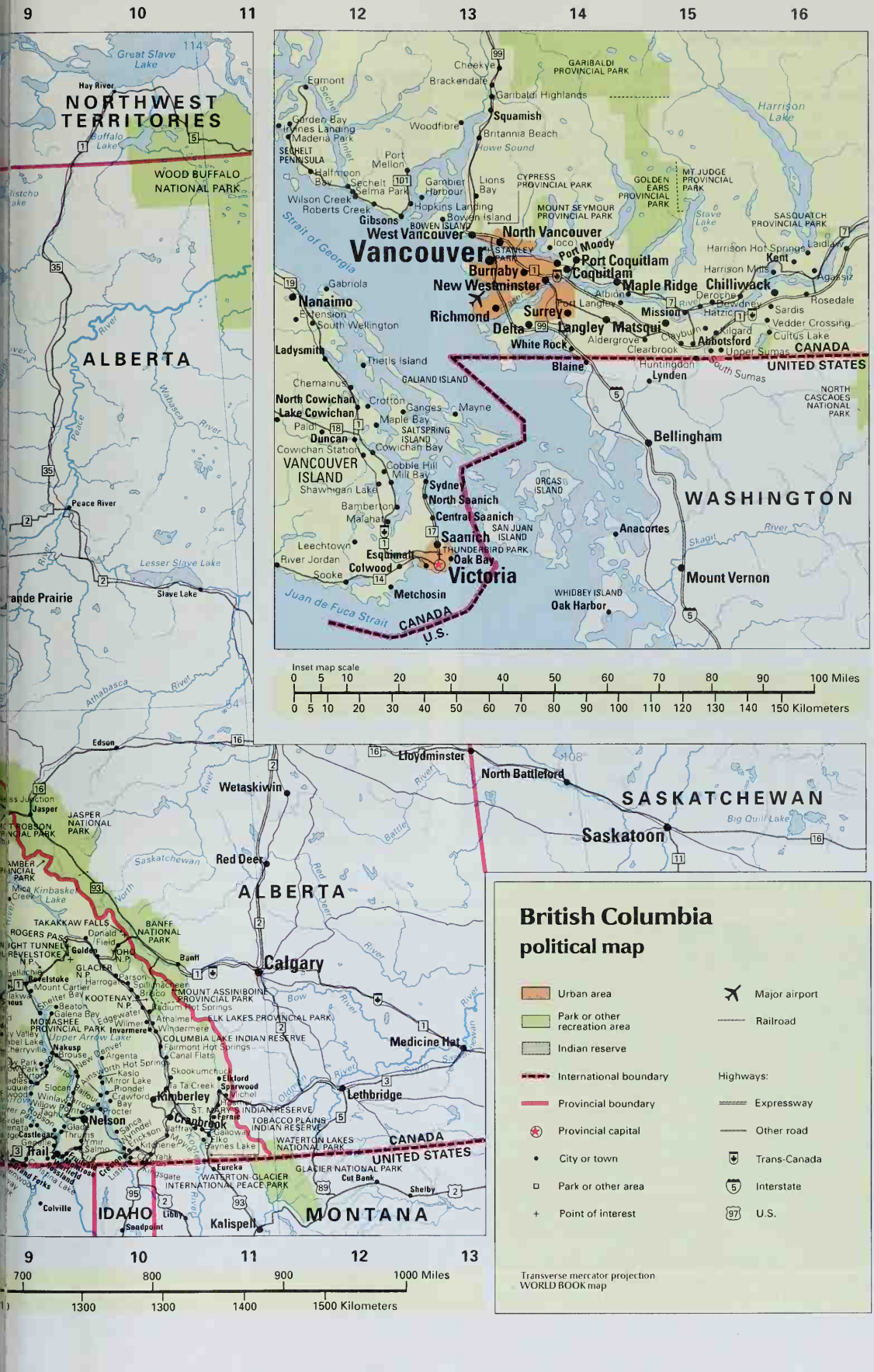
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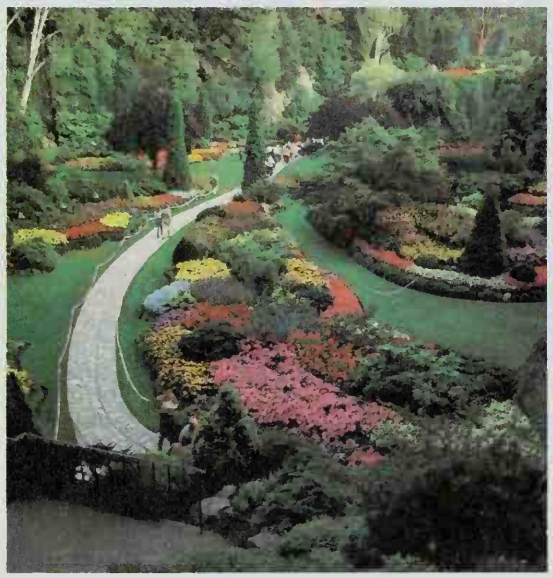
NORTHWEST TERRITORIES
Great Slave Lake
Hay River
WOOD BUFFALO NATIONAL PARK
ALBERTA
Peace River
Lesser Slave Lake
Slave Lake
Grande Prairie
Athabasca River
Edson
Wetaskiwin
Red Deer
Lloydminster
North Battleford
SASKATCHEWAN
Saskatoon
Big Quill Lake
Calgary
Medicine Hat
Lethbridge
Banff
Jasper
JASPER NATIONAL PARK
BANFF NATIONAL PARK
KOOTENAY N.P.
YOHO N.P.
GLACIER N.P.
MOUNT ASSINIBOINE PROVINCIAL PARK
KLAK LAKES PROVINCIAL PARK
COLUMBIA LAKE INDIAN RESERVE
ST. MARY'S INDIAN RESERVE
TOBACCO PLAINS INDIAN RESERVE
WATERTON LAKES NATIONAL PARK
GLACIER NATIONAL PARK
WATERTON-GLACIER INTERNATIONAL PEACE PARK
Kimberley
Cranbrook
Nelson
Trail
Castlegar
Revelstoke
Golden
Invermere
Fernie
Sparwood
Elkford
Eureka
Libby
Kalispell
Cut Bank
Shelby
Colville
Sandpoint
IDAHO
MONTANA
CANADA
UNITED STATES
U.S.
Vancouver
North Vancouver
West Vancouver
Burnaby
New Westminster
Richmond
Surrey
Delta
Langley
Matsqui
Abbotsford
Mission
Maple Ridge
Port Coquitlam
Coquitlam
Port Moody
Chilliwack
Squamish
Whistler
Garibaldi Highlands
Britannia Beach
Howe Sound
Harrison Lake
Harrison Hot Springs
Agassiz
Hope
Nanaimo
Ladysmith
Chemainus
Duncan
Cowichan Station
North Cowichan
Lake Cowichan
Crofton
Ganges
Mayne
Maple Bay
SALTSPRING ISLAND
GALIANO ISLAND
THETIS ISLAND
VANCOUVER ISLAND
Shawnigan Lake
Cobble Hill
Mill Bay
Sooke
Colwood
Metchosin
Esquimalt
Oak Bay
Victoria
Saanich
Central Saanich
North Saanich
Sidney
Bamberton
Malahat
Leechtown
River Jordan
Juan de Fuca Strait
ORCAS ISLAND
SAN JUAN ISLAND
THUNDERBIRD PARK
WHIDBEY ISLAND
Oak Harbor
Anacortes
Bellingham
Mount Vernon
Blaine
Lynden
Huntingdon
South Sumas
Aldergrove
Clearbrook
Upper Sumas
Abbotsford
Langley
Fort Langley
Albion
Pitt Meadows
Port Coquitlam
Pitt River
Pitt Lake
Lake Harrison
Stave Lake
Harrison Mills
Kent
Laidlaw
Deroche
Sardis
Vedder Crossing
Cultus Lake
Rosedale
Chilliwack
Agassiz
Hatzic
Kilgard
Clayburn
Cheakamus
Brackendale
Egmont
Garden Bay
Irvines Landing
Madeira Park
SECHELT PENINSULA
Halfmoon Bay
Sechelt
Selma Park
Wilson Creek
Roberts Creek
Gibsons
Port Mellon
Woodfibre
Gambier Harbour
Lions Bay
Hopkins Landing
Bowen Island
BOWEN ISLAND
Strait of Georgia
Gabriola
Extension
South Wellington
Cheakamus
GARIBALDI PROVINCIAL PARK
CYPRESS PROVINCIAL PARK
MOUNT SEYMOUR PROVINCIAL PARK
GOLDEN EARS PROVINCIAL PARK
MT JUDGE PROVINCIAL PARK
SASQUATCH PROVINCIAL PARK
NORTH CASCADES NATIONAL PARK
CANADA
UNITED STATES
Inset map scale
0 5 10 20 30 40 50 60 70 80 90 100 Miles
0 5 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 Kilometers
British Columbia
political map
Urban area
Park or other recreation area
Indian reserve
International boundary
Provincial boundary
Provincial capital
City or town
Park or other area
Point of interest
Major airport
Railroad
Highways:
Expressway
Other road
Trans-Canada
Interstate
U.S.
Transverse mercator projection
WORLD BOOK map
700 800 900 1000 Miles
1300 1300 1400 1500 Kilometers

British Columbia is a favorite area for tourists from Canada and the United States. Visitors can buy imported British goods and antiques in Victoria, Vancouver, and other southwestern coastal cities. Tourists in Victoria enjoy the stone parliament buildings, winding streets, and trim gardens that lead people to call the city "a bit of old England." Native carvings and other artwork in parks and museums recall the province's history.

Magnificent mountains and coastal scenery are among British Columbia's chief attractions. Numerous highways running through the province offer views of snow-capped peaks, thick green forests, and sparkling lakes and streams. Ferries and shipping lines operate among the coastal cities and between the coastal islands and the mainland. Passengers are treated to views of steep mountains rising from the sea, and of forested islands. Several hot spring resorts in British Columbia are also popular with visitors.

The province offers skiing in the mountains and water sports on the southern lakes. Mountainside ski villages are especially popular. Visitors enjoy British Columbia's vast unspoiled wilderness with its variety of wildlife, including bears, eagles, and elk. Anglers catch steelhead, salmon, and other prized game fish.

British Columbia has many cultural attractions. In Vancouver, tourists visit the Vancouver Art Gallery and the H. R. MacMillan Space Centre, which includes a planetarium. The Maritime Museum of British Columbia and the Royal British Columbia Museum are located in Victoria.



Cindy McIntyre, West Stock

Butchart Gardens in Victoria

John de Visser, Masterfile

Showtime at Barkerville Historic Town

Places to visit

Following are brief descriptions of some of British Columbia's most interesting places to visit:

B.C. Place Stadium, in Vancouver, has one of the largest air-supported domes in the world. It was built for Expo 86—the World Exposition on Transportation and Communication.

Butchart Gardens, in Victoria, features beautiful flowers, lawns, ponds, shrubs, and trees.

Gastown, in Vancouver, is an area named for "Gassy Jack" Deighton, an early resident. He was called "Gassy" because he was so talkative. The area has buildings from the 1880's and the world's only working steam clock.

Granville Island, in Vancouver, is a haven for boaters, theatergoers, sightseers, and artists.

Inside Passage to Alaska, one of the most scenic water routes in the world, runs from Seattle, Washington, and Vancouver to Prince Rupert, and on to Juneau and other Alaskan ports.

Kamloops area and the Okanagan Valley are noted for their scenery. In spring, fruit farms in irrigated areas are blanketed with blossoms. The valley is also known for its water sports and wineries.

'Ksan Historical Village and Museum, in Hazelton, is a reconstruction of a Gitxsan village that stood on the site in the 1800's. It is a living museum and cultural center.

Stanley Park, in Vancouver, is an area of forests, formal gardens, and picnic grounds.

Thunderbird Park, in Victoria, has a notable collection of totem poles. The park is next to the Royal British Columbia Museum, which features natural history displays.

National parks and sites. British Columbia has six national parks. Glacier and Mount Revelstoke national parks are in the Selkirk Mountains, and Kootenay and Yoho national parks are in the Rockies. Gwaii Haanas National Park is in the Queen Charlotte Islands, and Pacific Rim National Park is on Vancouver Island. British Columbia has a number of national historic sites, such as Fort Langley, Fort Rodd Hill, and Fort St. James. See **Canada** (National Park System).

Provincial parks. British Columbia has more than 675 provincial parks, recreational areas, and ecological reserves. Tweedsmuir, in the Coast Mountains near Bella Coola, is the largest provincial park. Barkerville, in the Cariboo Mountains, is a restoration of a historic gold rush town. For information on the provincial parks and recreational areas of British Columbia, write to BC Parks, Second Floor, 800 Johnson Street, Victoria, BC V8V 1X4. The Web site of BC Parks at www.elp.gov.bc.ca/bcparks provides detailed information on British Columbia's provincial parks.

Bill Staley, Masterfile

Gastown steam clock in Vancouver

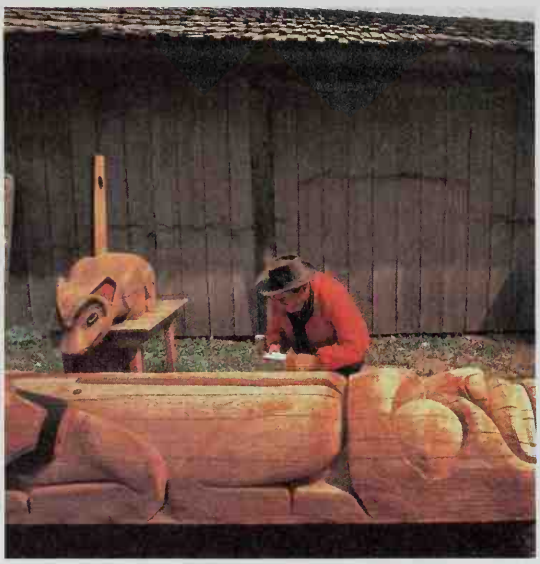
Annual events

January-June

Kimberley Winterfest (February); Pacific Rim Whale Festival in Tofino (mid-March); TerrifVic Jazz Party in Victoria (April); World Ski and Snowboard Festival in Whistler (April); Hyack Festival, New Westminster (May); Swiftsure Lightship Classic Sailing Races in Victoria (late May); Williams Lake Stampede (June).

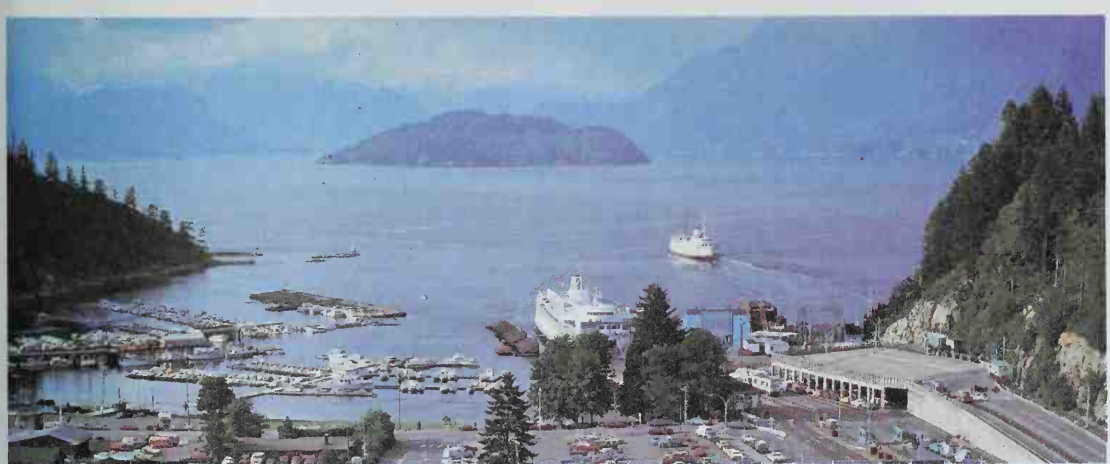
July-December

Billy Barker Days in Quesnel (July); Nanaimo Marine Festival (July); Old Time Accordion Championships in Kimberley (July); Celebration of Lights in Vancouver (July-August); World's Invitational Gold Panning Championships in Taylor (August); Squamish Days Logger Sports (August); Classic Boat Festival in Victoria (August); Okanagan Valley Wine Festival (October); Ladysmith Festival of Lights (November).



John de Visser, Masterfile

Carving a totem pole at a 'Ksan village in Hazelton



Keith Gunnar, West Stock

Horseshoe Bay, near Vancouver, part of the scenic Inside Passage to Alaska

Land regions. Most of British Columbia is covered by a belt of parallel mountain ranges that extend northwest and southeast. This mountain mass is called the *Cordillera.* It is about 300 miles (480 kilometers) wide at the northern boundary of the province and about 500 miles (800 kilometers) wide at the southern border.

British Columbia has six main land regions: (1) the Insular Mountains, (2) the Lower Fraser Valley, (3) the Coast Mountains, (4) the Interior Plateau, (5) the Eastern Mountains, and (6) the Transmontane Plains.

The Insular Mountains are part of a mountain range that lies mostly under the ocean and is an extension of the Olympic Mountains in the U.S. state of Washington. The higher parts form the many islands along British Columbia's coast. Vancouver Island, by far the largest, is 285 miles (459 kilometers) long and averages 60 miles (97 kilometers) in width. Some of its peaks are over 5,000 feet (1,500 meters) high. But its east coast is a broad, rolling lowland. The Queen Charlotte Islands are also part of the submerged range. These islands have a large swampy lowland in the northeast.

The Lower Fraser Valley is a delta region in the southwestern corner of the mainland. Dikes protect much of the lowlands from being flooded. The Lower Fraser Valley is the main farming region of the province. This region has fertile soils and a mild climate.

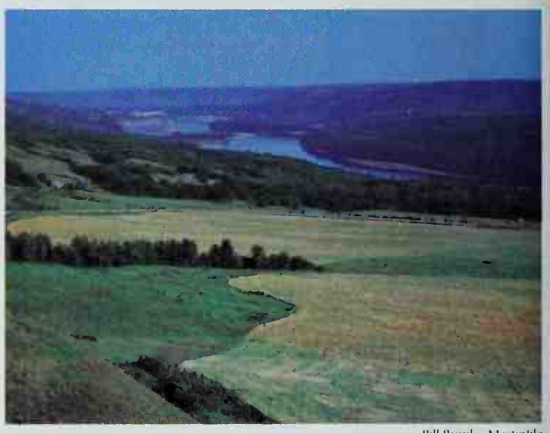
The Coast Mountains extend northwestward from the Lower Fraser Valley into the Yukon Territory and Alaska Panhandle. They give the mainland a high, indented coastline. Mount Fairweather, the highest point in British Columbia, rises 15,300 feet (4,663 meters) in the Coast Mountains on the Alaskan border. Mount Waddington, the tallest peak in the southern Coast Mountains, is 13,104 feet (3,994 meters) high.

The Interior Plateau lies east of the Coast Mountains. The southern section of this region has several long, narrow lakes and rivers. Some lake and river valleys, such as the Nicola, Okanagan, and Thompson, are important farming, fruit-growing, and grazing areas. The Cascade Mountains of Oregon and Washington extend into British Columbia. These mountains form the southwestern boundary of the Interior Plateau. The northern part of the plateau is forested and has large areas of level ground.

The Eastern Mountains include the Rocky Mountains along British Columbia's eastern border, the Cassiar-Omineca Ranges in the north, and the Columbia Mountain System in the southeast. The Cariboo, Monashee, Purcell, and Selkirk ranges form the Columbia System. The Rocky Mountain Trench, a long, narrow valley, lies between the Columbia Mountains and the Rocky Mountains in the south. In the north, it is east of the Cassiar-

Land regions of British Columbia

World Book map



Bill Brooks, Masterfile

The Peace River Valley includes grass-covered hills along the Peace River near Fort St. John. The valley is part of the Transmontane Plains region of northeastern British Columbia.

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Juan de Fuca, Strait of E 10
Kechika R. B 9
Kenney Dam D 10
Kicking Horse Pass E 14
King Island D 9
Knight Inlet E 10
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Yoho Natl. Park E 14

British Columbia physical map
Distance scale
0 25 50 75 100 125 150 Miles
0 50 100 150 200 Kilometers
Provincial capital
Other capital
City or town
Gulf of Alaska
Pacific Ocean
Queen Charlotte Sound
Queen Charlotte Strait
Dixon Entrance
Hecate Strait
Georgia Strait
Juan de Fuca Str.
Yukon Terr.
N.W.T.
Alaska
Alberta
Saskatchewan
Montana
Idaho
Washington
Prince Rupert
Kitimat
Prince George
Vancouver
Victoria
Edmonton
Calgary
Lethbridge
Medicine Hat
Kamloops
Dawson Creek
Fort Nelson
Fort McMurray
Peace River
Grand Prairie
Lower Post
Watson Lake
Whitehorse
Atlin
Skagway
Juneau
Sitka
Ketchikan
Yakutat Bay
Mt. Robson 12,972 FT. (3,954 M)
Mt. Waddington 13,177 FT. (4,016 M)
Mt. Sir Alexander 10,740 FT. (3,274 M)
Mt. Roosevelt 9,750 FT. (2,972 M)
Mt. Ratz 10,290 FT. (3,136 M)
Mt. Lyell 11,550 FT. (3,520 M)
Mt. Assiniboine 11,870 FT. (3,618 M)
Gott Pk 9,700 FT. (2,957 M)
Mt. Spranger 9,920 FT. (3,024 M)
Mt. Revelstoke 9,751 FT. (2,972 M)
Mt. Farnham 11,378 FT. (3,468 M)
Monarch Mtn 11,590 FT. (3,533 M)
Mt. Logan 19,850 FT. (6,050 M)
Mt. St. Elias 18,008 FT. (5,489 M)
Mt. Fairweather 15,300 FT. (4,663 M)
Pine Pass 2,850 FT. (869 M)
Yellowhead Pass 3,717 FT. (1,133 M)
Crowsnest Pass 4,450 FT. (1,356 M)
Sifton Pass
Monkman Pass
Kenney Dam
W. A. C. Bennett Dam
Mica Dam
Revelstoke Dam
Peace Canyon Dam
Caribou Mts. 3,265 FT. (995 M)
Clear Hills 3,666 FT. (1,117 M)
Swan Hills 4,525 FT. (1,379 M)
Pelican Mts. 3,100 FT. (945 M)
Primrose L.
Lac la Biche
Elk Island Nat'l. Park
Blackfoot Hills
Neutral Hills
Sullivan L.
Red Deer
Buffalo L.
Wood Buffalo Nat'l. Park
Birch Mts.
Clearwater River
Athabasca River
Lake Athabasca
Slave River
Peace River
Liard River
Fort Nelson River
Petitot River
Hay River
Buffalo Head Hills
Caribou Mts.
Stikine Ranges
Skeena Mts.
Omineca Mts.
Cassiar Mts.
Rocky Mts.
Hazelton Mts.
Babine Range
Telegraph Range
Chilcotin Range
Cascade Range
Purcell Mts.
Selkirk Mts.
Columbia Mts.
Queen Charlotte Islands
Graham I.
Moresby I.
Banks I.
Porcher I.
Princess Royal I.
Aristazabal I.
Kunghit I.
Dall I.
Revillagigedo I.
Prince of Wales I.
Chichagof I.
Baranof I.
Kruzof I.
Kuiu I.
Kupreanof I.
Admiralty I.
Alexander Archipelago
Vancouver Island
Strathcona Prov. Park 7,216 FT. (2,200 M)
Garibaldi Prov. Park
Golden Ears Prov. Park
Wells Gray Prov. Park
Mt. Robson Prov. Park
Yoho N. P.
Kicking Horse Pass
Glacier N. P.
Mt. Revelstoke Nat'l. Park
Mt. Coin Nat'l. Park
Kootenay Nat'l. Park
Waterton Lakes Nat'l. Park
Glacier Nat'l. Park
Kokanee Glacier Prov. Park
Pacific Rim Nat'l. Park
Olympic Nat'l. Park
Cascade Range
Longitude West of Greenwich
Specially created for The World Book Encyclopedia by Rand McNally and World Book editors

Omineca Ranges. The trench forms a north-south route from Montana to the Yukon Territory. Several rivers, including the Kootenay, Columbia, Fraser, Parsnip, and Finlay, flow along the trench.

The Transmontane Plains are flat lands and hilly lands that lie in the northeastern corner of the province. The Peace River District is the most developed part of the region.

Coastline of British Columbia is 15,985 miles (25,725 kilometers) long. The province's many islands account for about three-fourths of the total coastline. High mountains rise along most of the coastline. Narrow inlets extend far inland. The narrow waterway between the small islands near the coast and the Queen Charlotte Islands and Vancouver Island is called the *Inside Passage*. It provides a sheltered passageway for ships.

Rivers, waterfalls, and lakes. Most of the chief rivers of British Columbia drain into the Pacific Ocean. The Fraser River begins in the Rocky Mountains and winds 850 miles (1,370 kilometers) to the Pacific. The Nechako, Quesnel, Chilcotin, and Thompson flow into the Fraser. The Columbia River begins in southeastern British Columbia. It flows northward along the Rocky Mountain Trench. Then it makes its "big bend" around the north end of the Selkirk Mountains and flows southward into the state of Washington. The Canadian part of the Columbia is 460 miles (740 kilometers) long. The Kootenay River is the chief tributary of the Columbia in British Columbia. The Okanagan River flows southward through south-central British Columbia and enters the Columbia in Washington.

In northwestern British Columbia, the Skeena and Stikine rivers cut through the Coast Mountains and empty into the Pacific Ocean. The Nass River flows from the Skeena Mountains into Portland Inlet.

The Peace and Liard rivers in northeastern British Columbia flow eastward through the northern Rockies. They are part of the Mackenzie River System, which empties into the Arctic Ocean.

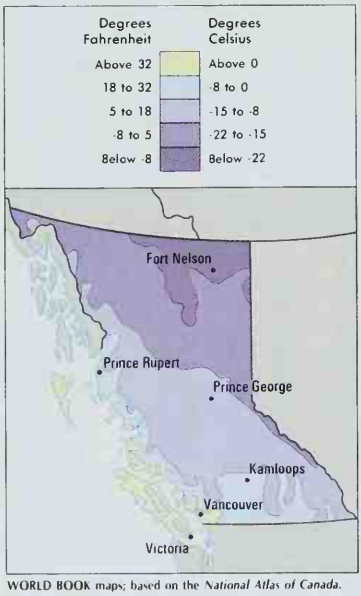
British Columbia's many waterfalls include Della Falls (1,443 feet, or 440 meters high) on central Vancouver Island, Hunlen Falls (900 feet, or 274 meters) near the Bella Coola River in the Coast Mountains, and Takakkaw Falls (833 feet, or 254 meters) in the Yoho Valley of the Rockies.

British Columbia has many lakes. Okanagan and Shuswap in south-central British Columbia are among many lakes in the province that attract tourists and campers. The largest natural lake entirely within the province is Babine Lake, covering 250 square miles (647 square kilometers). The largest lake is Williston Lake,

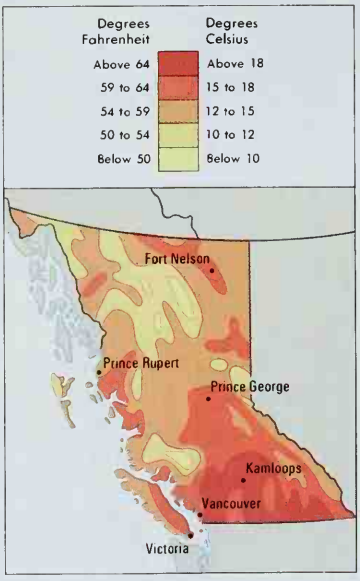
Average monthly weather

	Vancouver					Prince George				
	Temperatures				Days of rain or snow	Temperatures				Days of rain or snow
	°F		°C			°F		°C		
	High	Low	High	Low		High	Low	High	Low	
Jan.	42	33	6	1	19	24	5	−4	−15	15
Feb.	46	34	8	1	16	31	8	−1	−13	12
Mar.	51	37	11	3	16	42	19	6	−7	12
Apr.	58	42	14	6	13	54	28	12	−2	11
May	65	47	18	8	10	65	36	18	2	12
June	70	52	21	11	11	70	43	21	6	14
July	74	55	23	13	6	74	45	23	7	16
Aug.	74	54	23	12	7	73	43	23	6	13
Sept.	67	50	19	10	9	64	37	18	3	14
Oct.	58	45	14	7	15	52	31	11	−1	16
Nov.	49	39	9	4	17	36	21	2	−6	16
Dec.	44	35	7	2	19	26	10	−3	−12	15

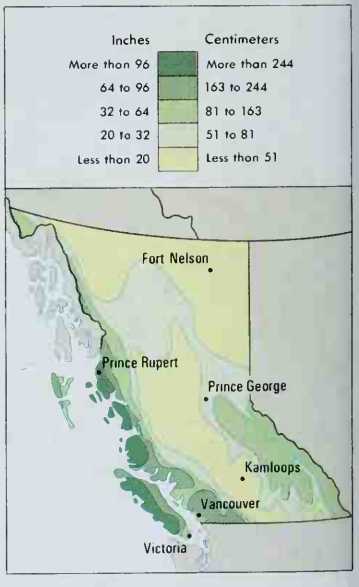
Average January temperatures
Mild winds from the Pacific Ocean keep British Columbia's coast warmer in winter than the northwestern inland area.



Average July temperatures
British Columbia has mild summers. The southern portion is the warmest and the northern mountains are the coolest.



Average yearly precipitation
Moist ocean winds bring heavy rains to the British Columbia coast. The inland areas of the province are much drier.



WORLD BOOK maps; based on the *National Atlas of Canada*.

formed by the W.A.C. Bennett Dam on the Peace River. The lake covers 680 square miles (1,761 square kilometers).

Plant and animal life. Forests cover about 230,000 square miles (600,000 square kilometers) of British Columbia, or about 15 percent of Canada's forestland. Most of this land is on Vancouver Island, the Queen Charlotte Islands, the Coast Mountains, the western slopes of the Columbia Mountains, and the central interior around Prince George. Hemlock, fir, and spruce are the province's most valuable timber trees. Wildflowers, such as bleeding hearts, Pacific dogwoods, shooting stars, and yellow arums grow in many parts of British Columbia.

British Columbia has bear, caribou, deer, elk, moose, mountain goat, and mountain sheep, and such fur-bearing animals as beaver, lynx, and marten. Grouse, pheasant, and other game birds are plentiful. In addition, both the coastal and inland waters abound with fish.

Climate. Mild winds from the Pacific Ocean warm British Columbia's coast in winter and cool it in summer. Average temperatures are 30 to 40 °F (−1 to 4 °C) in January and between 60 and 70 °F (between 16 and 21 °C) at most points in July. The Coast Mountains keep this mild air from reaching the interior, which receives cold air from the Yukon Territory in winter. Average temperatures at Kamloops, in the south, are 23 °F (−5 °C) in January and 70 °F (21 °C) in July. The Peace River District in the northeast averages 5 °F (−15 °C) in January and 60 °F (16 °C) in July. The province's highest temperature, 112 °F (44 °C), was recorded at Lytton, Lillooet, and Chinook Cove, on July 16 and 17, 1941. The lowest was −74 °F (−59 °C) at Smith River on Jan. 31, 1947.

Moist ocean winds bring much rain to the coastal regions, especially in autumn and winter. When winds rise over mountain ranges, much of their moisture condenses and falls on the western slopes. Land areas just east of the ranges may be dry. Western Vancouver Island gets over 100 inches (250 centimeters) of *precipitation* (rain, melted snow, and other forms of moisture) annually, but Victoria, on the east coast, gets only about 34 inches (86 centimeters). The Peace River District gets about 18 inches (46 centimeters). The Thompson and Okanagan valleys get less than 10 inches (25 centimeters).

Economy

Since the mid-1900's, service industries have grown in importance throughout British Columbia, especially in the Vancouver area. In the rest of the province, the economy is based heavily on such natural resources as forests and mineral deposits. Tourism is also important to the economy. Spending by tourists benefits many of the province's service industries.

Natural resources. British Columbia's chief natural resources include large timber reserves, mineral deposits, many fish and game animals, an abundant water supply, and small areas of good soil.

Minerals. British Columbia currently produces about 30 different kinds of mined products. Coal, copper, gold, lead, molybdenum, natural gas, petroleum, silver, and zinc are the most important. There is still much exploration, especially for coal and copper.

Soil. Much of the land in British Columbia is mountainous or forested, and is not suitable for raising crops. However, the southern interior valleys have brown soils that, with irrigation, are excellent for growing crops. The Lower Fraser Valley has rich alluvial soils.

Service industries account for the largest portion of British Columbia's *gross domestic product* (GDP)—the total value of all goods and services produced in the province in a year. Most of these industries are in the Vancouver metropolitan area.

Community, business, and personal services form the leading economic activity in British Columbia. This industry group provides a greater portion of the gross domestic product and employs more people than any other economic activity in the province. Businesses within this group include computer services, education, engineering services, health care, hotels, legal services, restaurants, repair shops, and ski resorts.

Finance, insurance, and real estate form the second most important industry group in British Columbia in terms of the gross domestic product. The Vancouver area is the leading financial center of western Canada. Many large banks operate there.

Wholesale and retail trade ranks next among service industry groups. The wholesale trade of farm products, forest products, and motor vehicles is a major contributor to the province's economy. Retail establishments benefit from spending by tourists. Other service industry groups are transportation and communication, and government. Provincial government activities are centered in Victoria, the province's capital. Information about transportation and communication appears later in this section.

Production and workers by economic activities

Economic activities	Percent of GDP* produced	Employed workers: Number of people	Employed workers: Percent of total
Community, business, & personal services	25	808,600	41
Finance, insurance, & real estate	22	119,500	6
Manufacturing	12	205,400	10
Wholesale & retail trade	11	303,200	15
Transportation & communication	10	213,700	11
Construction	5	112,500	6
Government	5	89,700	5
Forestry & fishing	4	†	†
Mining	3	55,400	3
Utilities	2	11,300	1
Agriculture	1	29,700	2
Total	100	1,949,000	100

*GDP = gross domestic product, the total value of goods and services produced in a year.
†Included in Mining.
Figures are for 2000.
Source: Statistics Canada.

Manufacturing. Goods made in British Columbia have a *value added by manufacture* of about 15 billion Canadian dollars a year. This figure represents the difference between the value of raw materials and the value of finished products made from the raw materials.

Wood products are British Columbia's most important goods in terms of value added by manufacture. For many years, small sawmills were scattered throughout British Columbia's forested regions. Today, huge modern sawmills turn out most of the province's wood products. British Columbia produces more lumber than any other Canadian province or any U.S. state.

Paper products production is British Columbia's second most important type of manufacturing activity. The province ranks among the leading U.S. states and Canadian provinces in the manufacture of paper products. Some companies that make wood products operate paper mills alongside their large sawmills.

Food and beverage processing ranks third among British Columbia's manufactured products in terms of value added by manufacture. Plants in the area produce large amounts of poultry, meat, fish, fruits and vegetables, and dairy products. A variety of beverages are also made in the province.

Other types of manufactured products made in British Columbia include computer and electronic products, fabricated metal products, machinery, primary metals, and transportation equipment.

Mining. Most of British Columbia lies within the Western Cordillera, a geological formation rich in minerals. Improved technology in mining and exploration has helped increase mined products production since the mid-1900's. Natural gas and coal are the leading sources of mining income in British Columbia. Most of the coal produced in the province is used to make steel and other metals. Copper is the province's most valuable metal. It is mined in the interior and on Vancouver Island. British Columbia's other important mined products include cement, gold, lead, molybdenum, petroleum, sand and gravel, silver, and zinc.

Forestry. Forests cover nearly half of British Columbia's land. Evergreen forests make up more than 95 percent of the forestland. About two-thirds of the timber is harvested from the interior areas, and about a third comes from the coastal area.

About 95 percent of British Columbia's forestland is publicly owned or administered. The amount of sawlogs and pulpwood that logging companies may cut in certain areas is set by law. The British Columbia Forest Service protects timber on public lands against diseases, fire, and insects.

Agriculture. Only about 3 percent of the land in British Columbia is suitable for farming. However, the farmland that does exist is very productive.

The province has about 22,000 farms. Since the 1970's, the province's crop farming industry has seen many changes. British Columbia is Canada's second-largest producer of nursery products and ornamental flowers, after Ontario. These products now are the province's leading source of farm income. Dairy products rank second. Farmers have started producing new crops such as the herb ginseng. Such products as berries, grapes, and greenhouse vegetables have also become important income sources for the province's farmers.

The Fraser Valley is British Columbia's most concentrated farming region. Dairy products, eggs, hogs, poultry, and vegetables are some of the important commodities produced there. The Central Interior is known for its cattle industry. Nearly all of the province's tree-fruits and wine grapes are grown in the Okanagan region. Eighty-five percent of the province's grain production takes place in the Peace River area. Canola, cattle, livestock feed, grass seed, and honey are also major commodities of the region.

Economy of British Columbia

This map shows the economic uses of land in British Columbia and where the province's leading farm, mineral, and forest products are produced. The major urban areas (shown in red) are the province's most important manufacturing centers.

WORLD BOOK map

Fishing industry. British Columbia is a leader among the Canadian provinces in commercial fishing. The value of its yearly fish catch is over 600 million Canadian dollars. The salmon catch usually makes up about half of this total. Other seafoods caught include clams, cod, crab, halibut, herring, oysters, rockfish, and shrimp.

Electric power. British Columbia's many fast-flowing rivers provide enormous potential hydroelectric power. About 90 percent of its electric power comes from hydroelectric plants. British Columbia has developed only a part of its water resources. But it still ranks high among the provinces in developed hydroelectric power. The rest of British Columbia's power comes from plants that burn natural gas, petroleum, or wood waste.

Transportation developed slowly in British Columbia. Mountains made it difficult to build roads and railroads. In the 1860's, workers hacked through 385 miles (620 kilometers) of canyon walls to build the Cariboo Road into the gold rush country. The province has about 26,000 miles (42,000 kilometers) of roads. More than half are paved. The Alaska Highway in the northeast helps link Dawson Creek with Fairbanks, Alaska. The Trans-Canada Highway crosses the province in the south.

Canada's first transcontinental railroad, the Canadian Pacific Railway, was completed in 1885 at Craigellachie in British Columbia. The first transcontinental train reached Vancouver, the western end of the railroad, in 1887. The province has about 4,200 miles (6,800 kilometers) of mainland rail track. Canadian Pacific Railway and Canadian National Railways carry freight from eastern Canada to the ports of Prince Rupert and Vancouver. Rail America Inc. runs the Vancouver Island rail line. Several companies provide passenger service in the province. BC Ferries runs one of the largest ferry systems in the world. The fleet consists of 40 vessels operating on 26 routes between the province's coastal points.

Vancouver International Airport handles about 90 percent of the province's air passenger traffic. Regional air carriers provide service throughout the province.

Vancouver has Canada's busiest port, which serves as the main shipping center between Canada and Asia. In addition, coastal vessels carry freight, and tugs tow logs along the sheltered route called the Inside Passage. The passage extends from Seattle, Washington, and Vancouver northward to Prince Rupert, and on to Alaska cities.

Communication. British Columbia has modern communications facilities for providing telephone, broadcasting, cable, Internet, and other telecommunications services. About 150 newspapers, including about 15 dailies, are published in British Columbia. The *Victoria Gazette,* the province's first newspaper, was published from June 1858 until November 1859. The *Daily Colonist* appeared in December 1858. In 1980, it merged with the *Victoria Times* to form the *Times-Colonist.*

The province has about 130 radio stations and 10 TV stations. Cable TV is also available to most households.

Government

Lieutenant governor of British Columbia represents the British monarch in the province. He or she is appointed by Canada's governor general in council. The lieutenant governor's position is largely honorary, like that of the governor general.

Premier of British Columbia is the actual head of the provincial government. British Columbia has a parliamentary form of government. The leader of the political party with the most seats is appointed premier.

The premier presides over the Executive Council (cabinet). The council includes 20 to 30 other ministers chosen by the premier from among party members in the Assembly. Most council members direct one ministry of the provincial government. The government resigns if it loses the support of a majority of the Assembly.

Legislative Assembly makes the laws that govern the province. The Assembly has 79 members. Each is elected from a separate electoral district. The members of this legislature, which has only one house, serve terms that may last up to four years.

Courts. The highest court in British Columbia is the Court of Appeal. Provincial law provides for the chief

The premiers of British Columbia

	Party	Term		Party	Term
John F. McCreight	None	1871-1872	**Harlan C. Brewster**	Liberal	1916-1918
Amor De Cosmos	None	1872-1874	**John Oliver**	Liberal	1918-1927
George A. Walkem	None	1874-1876	**John D. MacLean**	Liberal	1927-1928
Andrew C. Elliott	None	1876-1878	**Simon F. Tolmie**	Conservative	1928-1933
George A. Walkem	None	1878-1882	**Thomas D. Pattullo**	Liberal	1933-1941
Robert Beaven	None	1882-1883	**John Hart**	Liberal	1941-1947
William Smythe	None	1883-1887	**Byron I. Johnson**	Liberal	1947-1952
Alexander E. Davie	None	1887-1889	**W. A. C. Bennett**	Social Credit	1952-1972
John Robson	None	1889-1892	**David Barrett**	New Democratic	1972-1975
Theodore Davie	None	1892-1895	**William R. Bennett**	Social Credit	1975-1986
John H. Turner	None	1895-1898	**William N. Vander Zalm**	Social Credit	1986-1991
Charles A. Semlin	None	1898-1900	**Rita Johnston**	Social Credit	1991
Joseph Martin	None	1900	**Michael Harcourt**	New Democratic	1991-1996
James Dunsmuir	None	1900-1902	**Glen Clark**	New Democratic	1996-1999
Edward C. Prior	None	1902-1903	**Dan Miller**	New Democratic	1999-2000
Richard McBride	Conservative	1903-1915	**Ujjal Dosanjh**	New Democratic	2000-2001
William J. Bowser	Conservative	1915-1916	**Gordon Campbell**	Liberal*	2001-

* The British Columbia Liberal Party broke its ties with the federal Liberal Party in 1991.

justice of British Columbia and 18 justices of appeal in this court. The Supreme Court is lower than the Court of Appeal. Legislation provides for a chief justice and 100 Supreme Court justices. The province also has about 155 judges in Provincial Court, the lowest-level court in British Columbia. The governor general in council of Canada appoints all judges of the three levels of courts.

Local government. British Columbia has about 150 *incorporated areas* (cities, towns, district municipalities, and villages). Each is governed by a council headed by a mayor. These officials are elected to three-year terms.

The province is divided into 27 regional districts, 1 unincorporated region, and the Islands Trust. Each district is governed by a regional board of representatives from the district's incorporated and unincorporated areas. The councils of incorporated areas appoint members to the regional board. These members serve until replaced. Voters in unincorporated areas elect representatives to the regional board. Elected members serve three-year terms. The provincial government acts to provide local services for the province's single unincorporated region.

Revenue. Taxes levied by the provincial government account for about 60 percent of British Columbia's *general revenue* (income). Most of this revenue is generated by taxes on personal income and retail sales. Corporate income and the sale of gasoline are also taxed.

About 15 percent of the province's general revenue comes from national and provincial tax-sharing arrangements and federal assistance. Other revenue comes from charges for the right to use natural resources, such as the right to cut timber on public land. The sale of liquor, which is under government control, and license and permit fees add to the province's income.

Tourism British Columbia

The Legislative Assembly of British Columbia meets in the Legislative Building in Victoria. The Assembly has 79 members.

Politics. Many political parties are active in British Columbia. Two of the main ones are the British Columbia Liberal Party and the New Democratic Party. The British Columbia Liberal Party is a right-of-center party that has no official ties to the federal Liberal Party of Canada. The New Democratic Party, which does have ties to the federal New Democratic Party, is a social-democratic party.

History

Early days. Indians lived in the British Columbia region long before Europeans arrived in the area. The Athabaskans in the north and the Salish in the southern interior were the most numerous groups at the time of European arrival. But the Haida, Kwakiutl, Nootka, and Tsimshian peoples were the richest and most advanced. They lived along the coast, catching whales, sea otters, salmon, and halibut for food. These Indians developed great artistic skills, and their carved totem poles are tourist attractions today. The Indians in the interior hunted and fished along the great rivers. They dug *keek-wilie houses* in the ground for winter shelter. These houses had roofs made of wood covered with earth. During the summer, the Indians lived in *mat lodges,* which were pole frameworks covered with fiber mats or branches.

European contact. In 1774, a Spanish fleet under Juan Pérez sighted the region that is now British Columbia, but did not land. Pérez and his crew were the first Europeans known to have seen British Columbia. The English explorer James Cook became the first European to land in the region. He led two British ships into Nootka Sound on the west coast of Vancouver Island in 1778. Cook was seeking a passage from the Pacific Ocean to the Atlantic. His crew traded clothes, beads, and knives to the Indians for otter skins and sold the skins in China and Europe. By 1786, the British had a flourishing fur trade with the Indians.

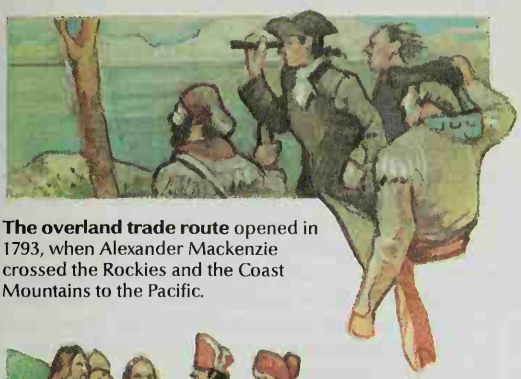
The Nootka Sound controversy between the Spaniards and the British developed in 1789. Spain claimed the Nootka Sound area because of Pérez's voyage, and because treaties between Spain and Portugal gave all land west of the Line of Demarcation to Spain (see **Line of Demarcation**). The Spaniards became alarmed at the growing British trade. They seized several British ships in Nootka Sound, and the two countries nearly went to war. The dispute was settled by the Nootka Convention of 1790. Ownership remained unsettled, but the British and the Spaniards received equal trading rights.

George Vancouver, an English explorer, set out in 1792 on a three-year survey of the Pacific Coast from Oregon to Alaska. On this voyage, he and his crew named many inlets and other coastal features.

The overland fur traders. Alexander Mackenzie, a Scottish fur trader from eastern Canada, crossed the Rocky Mountains and reached the Pacific Ocean in 1793. Two other members of the fur-trading North West Company, Simon Fraser and David Thompson, followed in 1805 and 1807, respectively. Fraser and Thompson opened fur-trading posts as they came west from eastern Canada. Their chain of posts became Canada's overland fur-trade route. In 1808, Fraser explored the river that now bears his name. Thompson reached the mouth of the Columbia River in 1811.

The border dispute. After 1821, the Hudson's Bay Company, a powerful British trading firm, controlled the fur trade in British Columbia. The company also controlled fur trading in the area that makes up present-day Washington and Oregon. During the late 1830's and early 1840's, many American settlers moved into the southern part of this region. They refused to recognize the authority of the British company and asked the United States to establish a government in the area.

Historic British Columbia

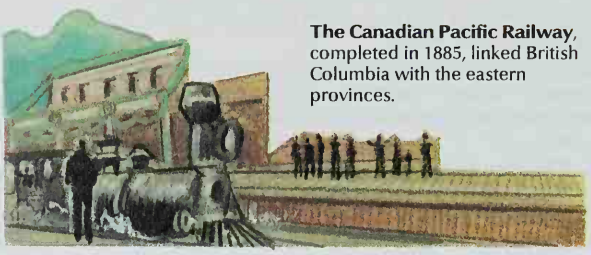


The overland trade route opened in 1793, when Alexander Mackenzie crossed the Rockies and the Coast Mountains to the Pacific.

Captain James Cook, an English explorer, opened the British fur trade with the Indians on Vancouver Island in 1778.

The Cariboo gold rush in the 1860's attracted thousands of prospectors to British Columbia.

Sir James Douglas, the first governor of the colony of British Columbia, served from 1858 to 1864. He also governed Vancouver Island from 1851 to 1863.



The Canadian Pacific Railway, completed in 1885, linked British Columbia with the eastern provinces.

Important dates in British Columbia

WORLD BOOK illustrations by Kevin Chadwick

1778 James Cook landed on Vancouver Island.

1790 The Nootka Convention gave the Spaniards and the British equal trading rights along the North Pacific Coast.

1792-1794 George Vancouver explored the coast.

1805-1808 Simon Fraser explored what is now British Columbia.

1843 The Hudson's Bay Company founded Fort Victoria.

1846 The Oregon Treaty set the boundary between British Columbia and the United States.

1849 The British established a colony on Vancouver Island.

1858 The British established the colony of British Columbia on the mainland during the gold rush to the Fraser River.

1861 The gold rush to the Cariboo District began.

1866 The British united the colonies of British Columbia and Vancouver Island.

1885 Canada's transcontinental railroad was completed.

1942 The Alaska Highway linked Dawson Creek with the Yukon Territory and Alaska.

1951 Major natural gas and oil fields were discovered near Fort St. John in the Peace River District.

1964 Canada and the United States reached final agreement on their 1961 treaty providing for development of the Columbia River in British Columbia and the state of Washington.

1972 The New Democratic Party became the first social-democratic party to form the provincial government. It remained in office until 1975.

1985 The province's Northeast B.C. Coal Project, the largest coal mining project in Canada, made its first shipment of coal.

2000 The Nisga'a Treaty, which settled land claims by the Nisga'a Indians of British Columbia, was ratified.

Democrats in the United States made U.S. claims to the area an issue in the 1844 presidential election campaign. They wanted the territory on the Pacific Coast as far north as latitude 54°40′, and they coined the slogan "Fifty-Four Forty or Fight." The British wanted the southern boundary of British territory to follow the 49th parallel from the Rocky Mountains to the Columbia River, and then to follow the river south and west. This would have given the British all of what is now western Washington. The Democrats won the election, and James K. Polk became president. He proposed a compromise, and the United States and the United Kingdom signed a treaty in 1846. The treaty set the 49th parallel as the southern boundary for all British territory except Vancouver Island. The British kept Vancouver Island, part of which lies south of the 49th parallel.

The colonial period. The Hudson's Bay Company founded Fort Victoria (now Victoria) in 1843. In 1849, the British government gave the company the responsibility for colonizing Vancouver Island. In 1851, James Douglas, an official of the company, became governor of the colony. Douglas established the legislative assembly of Vancouver Island in 1856.

The discovery of gold in the Fraser River region in the 1850's brought thousands of fortune hunters into the territory in 1858. They came by boat from San Francisco, crowding into Fort Victoria to buy supplies. They came overland by horse and wagon and on foot.

The British were anxious to strengthen their hold on the mainland region. They formed the colony of British Columbia in 1858. In 1859, the capital was established at New Westminster. Douglas became governor of the mainland colony and also continued as governor of Vancouver Island. The British united the colonies in 1866. New Westminster was the capital until 1868, when Victoria became the capital.

The colonists debated whether they should apply for annexation to the United States, or become a province in the new Dominion of Canada. In 1871, they agreed to become a part of Canada, on the condition that the federal government would build a railroad to link British Columbia with eastern Canada. John Foster McCreight became British Columbia's first premier.

Progress as a province. The union with the Dominion was an unhappy one at first. The government had promised to build the transcontinental railroad within 10 years. But construction did not start until 1881, and it proceeded slowly. The delay irked British Columbians, who threatened to withdraw from the Dominion. The railroad reached the province in 1885.

The young province soon ran heavily into debt. Spending ran far above revenues. Many people believed that the cost of governing a mountainous area with a scattered population such as British Columbia's would always be high. British Columbia's premier, Richard McBride, consulted with the Dominion about the question of aid. In 1906, the other provinces agreed that British Columbia should receive $1 million from the Dominion in annual payments of $100,000.

Railroad routes opened some of the central parts of the province between 1910 and 1920. The railroads speeded the development of lumber camps, mining, farming, and industries. British Columbia's fishing industry became the biggest in Canada. The province also became a leader in sawmill products and in lead and zinc production. Vancouver, already the western terminal for the Canadian Pacific Railway, became a leading world port after the Panama Canal opened in 1914. The canal provided a cheaper way to ship grain, lumber, and fish products to Europe and the eastern United States.

The mid-1900's were years of great progress in British Columbia. Widespread development took place in the northern part of the province. The 1,422-mile (2,288-kilometer) Alaska Highway opened in 1942. The highway extends from Dawson Creek, British Columbia, to Delta Junction, Alaska, where it links up with another highway and continues north to Fairbanks, Alaska.

In 1951, natural gas and oil were discovered near Fort St. John in the Peace River District of British Columbia. Pipeline construction boosted industrial expansion throughout the province. The Kemano hydroelectric project reversed the flow of the Nechako River to power an aluminum plant that began operating in Kitimat in 1954. In 1958, the Pacific Great Eastern Railway completed an extension north into the Peace River District.

In 1964, the Pacific Great Eastern built a branch rail line from Summit Lake to Fort St. James in the interior. This line opened much unused land to the logging and mining industries. It also brought important changes in the timber industry. Previously, logging had centered on the west coast and almost all the wood had been used for lumber. During the 1960's, the interior forests became important sources of wood.

In the 1960's, British Columbia opened new parts of the province for settlement and commercial development. The Social Credit government of Premier W. A. C. Bennett sponsored a series of long-term development programs. The major project, a hydroelectric power dam on the Peace River, started operating in 1968.

In 1964, Canada and the United States approved the Columbia River Treaty, which called for the construction of four dams on the Columbia River—three in Canada and one in the United States. The Duncan Dam was completed in 1967. The Hugh Keenleyside Dam was dedicated in 1969. The Libby Dam in northwest Montana began operating in 1972, and the Mica Dam was completed in 1973.

The late 1900's. Trade with Japan brought further growth to British Columbia's economy during the 1970's. Previously, British Columbia had looked to the eastern provinces and the United States for its major markets. In 1968, a coal company in British Columbia signed an agreement to export about 50 million tons (45 million metric tons) of coal to Japan over a 15-year period. In 1970, a port built by the provincial and federal governments to handle coal shipments opened at Roberts Bank, south of Vancouver. In the 1980's, coal deposits in the northeastern part of the province near Tumbler Ridge were developed to supply the Japanese market.

In 1971, the Pacific Great Eastern Railway reached Fort Nelson in the northeast. The line opened the way for development of the area's natural resources. In 1972, its name was changed to British Columbia Railway.

In 1972, British Columbia voters elected the province's first social-democratic government. David Barrett of the New Democratic Party headed the new government. In 1973, the provincial legislature set up government-owned corporations to compete with private firms in

the insurance and the pulp and paper industries. From 1975 to 1991, the Social Credit Party again governed British Columbia. In 1991, the New Democratic Party won control. It governed the province until 2001, when British Columbia's Liberal Party took control of the government after a huge victory over the New Democrats.

Expo 86, a worldwide exposition of communication and transportation technologies, was held in Vancouver in 1986. It helped promote tourism in the province. The construction of highways between Hope, Kamloops, and the Okanagan Valley in the late 1900's contributed to the development of the southern interior.

Recent developments. In 2000, the Canadian government ratified the Nisga'a Treaty, which settled land claims by the province's Nisga'a Indians. The treaty granted the Nisga'a control over about 775 square miles (2,000 square kilometers) of land in northern British Columbia as well as cash and other economic benefits. It also provided for a form of self-government for the Nisga'a. About 50 other Indian groups in British Columbia are also trying to negotiate treaties with Canada and the province. Robert A. J. McDonald and Graeme Wynn

Study aids

Related articles in *World Book* include:

Biographies

Campbell, Kim
Carr, Emily
Douglas, Sir James
Erickson, Arthur C.
Fox, Terry
Fraser, Simon

Cities

Kamloops
Kitimat
New Westminster
Prince George
Vancouver
Victoria

Physical features

Coast Ranges
Columbia River
Fraser River
Peace River
Puget Sound
Queen Charlotte Islands
Rocky Mountains
Selkirk Mountains
Skeena River
Takakkaw Falls
Vancouver Island

Other related articles

Alaska Highway
Bella Coola Indians
Flower (picture: Botanical gardens)
Inside Passage
Kutenai Indians
Kwakiutl Indians
Tsimshian Indians

Outline

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- C. Libraries and museums

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VI. History

Questions

What is the *Inside Passage?*
Who heads the government of British Columbia?
What is the capital of British Columbia?
Who was the first white person to land in the British Columbia region?
What is the province's leading manufacturing industry?
What brought wealth to the Peace River District of British Columbia during the 1950's?
Where do most of British Columbia's people live?
Why is the Lower Fraser Valley the main farming region?
What is British Columbia's largest natural lake?
What is the *Cordillera?*

Additional resources

Level I

Hancock, Lyn, and Krueger, Guenther. *Destination Vancouver.* Lerner, 1998.

LeVert, Suzanne. *British Columbia.* Chelsea Hse., 2000.

Nanton, Isabel. *British Columbia.* Rev. ed. Grolier, 1996.

Shemie, Bonnie. *Houses of Wood:Native Dwellings of the Northwest Coast.* Tundra, 1992.

Level II

Barman, Jean. *The West Beyond the West: A History of British Columbia.* Rev. ed. Univ. of Toronto Pr., 1996.

Fladmark, Knut R. *British Columbia Prehistory.* National Museums of Canada, 1986.

Francis, Daniel, ed. *Encyclopedia of British Columbia.* Harbour Pub., 2000.

McGillivray, Brett. *Geography of British Columbia: People and Landscapes in Transition.* Univ. of Br. Columbia Pr., 2000.

Sterne, Netta. *Fraser Gold 1858! The Founding of British Columbia.* Wash. State Univ. Pr., 1998.

Woodcock, George. *British Columbia.* Douglas & McIntyre, 1990.

British Columbia, University of, is a coeducational university in Vancouver, British Columbia. It ranks as one of Canada's largest schools. It has departments of agricultural sciences, applied science, arts, commerce and business administration, dentistry, education, forestry, graduate studies, law, medicine, pharmaceutical sciences, and science. The university grants bachelor's, master's, and doctor's degrees. Its library is one of Canada's largest research libraries.

The university has numerous research institutes and centers. These facilities include institutes of Asian research, international relations, and health promotion research, and centers for integrated computer systems research and metallurgical process engineering. The university also participates in national, federally funded networks on bacterial diseases, protein engineering, the genetic basis of human disease, and international development.

The University of British Columbia is supported by government grants, private donations, and student fees. It opened in 1915.

Critically reviewed by the University of British Columbia

British Commonwealth of Nations. See Commonwealth of Nations.

British Empire. See United Kingdom (History).

British Honduras. See Belize (History).

British Indian Ocean Territory is an overseas territory of the United Kingdom. It is in the Indian Ocean and consists of the Chagos Archipelago island group, which lies northeast of Madagascar. The islands cover a land area of about 30 square miles (78 square kilometers). The territory has no permanent population, but about 3,000 British military personnel and construction workers are stationed there. English is the official language.

The United Kingdom created the British Indian Ocean Territory in 1965. In 1966, the United Kingdom and the United States made it a military site for the two countries. The United States maintains a naval support facility on Diego Garcia, one of the islands (see **Diego Garcia**). The Aldabra Islands, Desroches Island, and the Farquhar group were part of the territory until 1976, when they became a part of Seychelles. Since 1982, Mauritius has claimed the Chagos Archipelago. Robert LaPorte, Jr.

British-Irish Council is a political body that addresses matters of concern to the United Kingdom and the Republic of Ireland. It is also known as the Council of the Isles. It brings together representatives from the national parliaments of Ireland and the United Kingdom; the assemblies of Northern Ireland, Scotland, and Wales; and the governments of the Channel Islands and the Isle of Man, which are British dependencies.

The council promotes cooperation on policy among the various governments by providing a forum for discussion of issues of mutual concern. It does not have the power to pass laws. The British-Irish Council was created as part of the 1998 political settlement concerning Northern Ireland. Brendan O'Leary

See also **Northern Ireland** (History).

British Isles is a name often used for one of the world's chief island groups. They are bounded by the English Channel, the Strait of Dover, the North Sea, and the Atlantic Ocean. The islands in the group are Great Britain, made up of England, Scotland, and Wales; Ireland, made up of Northern Ireland and the country of Ireland; the Isle of Man; the Hebrides; the Orkney Islands; the Shetland Islands; and about 5,500 small islands and islets. Some people object to the name *British Isles* because it seems to imply that Ireland is British. Each island or group of islands named above has an article in *World Book*. For location of the British Isles, see **Europe** (terrain map). Anthony Sutcliffe

British Library is the national library of the United Kingdom and one of the largest libraries in the world. The library, located in London and Yorkshire, has about 18 million books. It automatically receives a copy of each new book published in the United Kingdom. Its collections also include items from all over the world. Many of the most outstanding items are on permanent display, including two original copies of Magna Carta (see **Magna Carta**). The British Library was formed in 1973.

Critically reviewed by the British Library

See also **Library** (picture: The British Library).

British Museum, in London, is among the oldest of the world's great national museums. Many of its collections are among the finest in the world. The museum was founded in 1753 by an act of Parliament after Sir Hans Sloane, a British physician and botanist, willed his collections to the nation. The museum opened Jan. 15, 1759, in Montagu House in London's West End. In 1847, a new building replaced Montagu House, and many additions have since been made. The British Museum attracts more than 4 million visitors a year.

Purpose. The museum preserves and interprets the history of civilization. It specializes in ancient Mediterranean civilizations and medieval Europe. Its treasures include the sculptures called the Elgin Marbles from the Parthenon in Athens, and the Rosetta stone from Egypt (see **Elgin Marbles; Rosetta stone**). Also, the museum has important relics from the Aztec empire and from such ancient Mesopotamian cities as Ur and Nineveh.

Departments. The museum has 10 departments: (1) Prints and Drawings, (2) Coins and Medals, (3) Egyptian Antiquities, (4) Western Asiatic Antiquities, (5) Greek and Roman Antiquities, (6) Medieval and Later Antiquities, (7) Oriental Antiquities, (8) Prehistoric and Romano-British Antiquities, (9) Japanese Antiquities, and (10) Ethnography. Critically reviewed by the British Museum

British North America Act served as the main written part of Canada's constitution from 1867 until 1982. The Constitution Act of 1982 replaced it as the basic governing document of Canada.

The British Parliament passed the British North America Act in March 1867 to provide for the formation of the Dominion of Canada. The act took effect on July 1, 1867, and united the three British colonies of New Brunswick, Nova Scotia, and Canada. Under the act, these colonies became four provinces—New Brunswick, Nova Scotia, Ontario, and Quebec. The act divided the colony of Canada to create Ontario and Quebec.

The British North America Act established a federal union with a strong central government and limited provincial governments. Generally, the dominion government had the power to deal with matters of national interest. Each provincial government handled education, health, natural resources, and other local affairs.

The British Parliament amended the British North America Act many times. Canada won its independence from the United Kingdom in 1931, but amendments to the act continued to require British approval. This requirement finally ended when the British Parliament accepted Canadian proposals for a revised constitution and passed the Constitution Act of 1982. As a result of this act, the British North America Act was renamed the Constitution Act of 1867. Andrée Désilets

See also **Canada, Government of** (The constitution); **Canada Day; Confederation of Canada.**

British Petroleum Company. See BP Amoco.

British thermal unit, or Btu, is a unit used to measure heat in the inch-pound system of measurement customarily used in the United States. One Btu raises the temperature of 1 pound (0.454 kilogram) of water 1 Fahrenheit degree (0.556 Celsius degree). Raising the temperature of 5 pounds of water 20 Fahrenheit degrees requires 100 Btu's (5×20). Burning fuels release various amounts of heat. For example, a cubic foot of natural gas releases about 1,000 Btu's of heat. But a cubic foot of manufactured gas releases only about 550 Btu's. In the metric system, heat is measured in *calories* or in *joules*. One Btu equals 251.996 calories or 1,054.350 joules. See also **Calorie; Joule.** Leland F. Webb

British West Indies is a group of islands in the Caribbean Sea. It includes several overseas territories of the United Kingdom. These territories include Anguilla, Bermuda, the British Virgin Islands, the Cayman Islands, Montserrat, and the Turks and Caicos Islands. Together, the islands have an area of about 419 square miles (1,085 square kilometers) and a combined population of about 129,000.

Many other islands and territories in the Caribbean area were once members of the British West Indies, but they are now independent countries. Such countries include the Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, St. Lucia, St. Vincent and the Grenadines, and Trinidad and Tobago. Gary Brana-Shute

Britons. See **England** (History).

Brittany is a region in northwestern France. It covers the peninsula that separates the Bay of Biscay from the English Channel. Its name in French is *Bretagne*. Brittany is famous for its picturesque landscape and scenic small towns and cities. Brittany's people, who are called *Bretons,* are known for their independent spirit and old, local traditions.

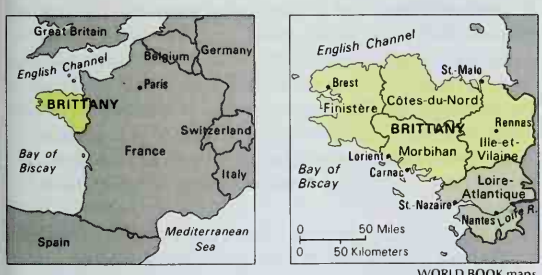
The region. The French government defines Brittany as the region covered by four *departments* (administrative districts): Finistère, Côtes-du-Nord, Ille-et-Vilaine, and Morbihan. This region covers 10,505 square miles (27,208 square kilometers) and has about 3 million people. Many Bretons claim that Brittany also includes the department of Loire-Atlantique.

Brittany's seacoast includes sandy beaches in the south and rocky land in the north. Fishing villages line the coast. Inland, small farms dot the landscape.

Brittany has several small cities, but no large urban areas. Rennes is the region's administrative center. Other cities include Brest, the site of a French naval base, and Lorient, a major fishing port.

St.-Malo, a town in Brittany, has many medieval structures that were restored after being destroyed during World War II (1939-1945). Numerous large stone structures called *megalithic monuments* stand near the town of Carnac. They were built by ancient inhabitants of Brittany (see **Megalithic monuments**).

Culture. Throughout most of its history, Brittany was isolated from the rest of France. Its people developed a culture that differed in many ways from that elsewhere in the country. They spoke the Breton language, which is related to Welsh. Many Bretons wore distinct local costumes as everyday clothing.



WORLD BOOK maps

Brittany occupies a peninsula in northwestern France, *left.* The detailed map, *right,* shows in yellow the territory that the French government considers Brittany. Many people also consider Loire-Atlantique to be part of Brittany.

During the 1900's, the differences between life in Brittany and the rest of France decreased. Today, most Bretons use French as their main language, and many cannot speak Breton. A small percentage of the people, especially older women, still wear traditional costumes every day, and many do so on special occasions. But most of the people now wear modern, Western-style clothing regularly.

Most Bretons are Roman Catholics, and Catholicism has a strong influence on the culture of the region. Church festivals that are held throughout the region are both religious and social events.

Economy. Fishing is a major industry in Brittany. Breton fishing crews bring in about a third of France's annual catch. Farming and tourism are also important to Brittany's economy.

History. People probably lived in Brittany before 8000 B.C. During the A.D. 400's to 600's, Celts from what are now the United Kingdom and Ireland settled the region. The Celts named their new home *Brittany* (Little Britain). For hundreds of years, the Celts fought a number of wars to remain independent from France. But Brittany officially became part of France in the 1400's.

Today, many Bretons are troubled by the decline of Breton culture. These people want to restore the importance of their culture. Most Bretons favor French rule of their region, though many call for greater control over local political affairs. A small group of Bretons want complete independence for Brittany. Some of them belong to the Breton Liberation Front, an illegal organization that has carried out several bombings to call attention to its goals. William M. Reddy

Brittany is a popular breed of hunting dog in the United States. It looks much like a long-legged spaniel and was officially called the *Brittany spaniel* for many years. However, in the field the Brittany performs like a setter, alerting the hunter by pointing its nose at game. The Brittany has a short, thick coat. Most of the dogs are either white with orange markings or white with *liver* (reddish-brown) markings. Many have a naturally short tail. Owners have the tail of many others *docked* (cut off) at birth. Most Brittanys weigh from 35 to 40 pounds (16

Catherine M. Murphy

The Brittany is a popular hunting dog.

to 18 kilograms) and stand about 17 $\frac{1}{2}$ to 20 $\frac{1}{2}$ inches (44 to 52 centimeters) at the shoulder.

Critically reviewed by the American Brittany Club

See also **Dog** (picture: Sporting dogs).

Britten, Benjamin (1913-1976), also called Lord Britten, was a British composer famous for his vocal music, especially operas. His operas include *Peter Grimes* (1945), *The Rape of Lucrecia* (1946), *Albert Herring* (1947), *Billy Budd* (1951), *The Turn of the Screw* (1954), *A Midsummer Night's Dream* (1960), *Owen Wingrave* (1971), and *Death in Venice* (1973).

Britten wrote much children's music. To introduce young people to music, he composed *The Young Person's Guide to the Orchestra* (1945). To involve them in musical performances, he wrote *Noye's Fludde* (1958). *Noye's Fludde*, a religious play with music, is based on a medieval miracle play and involves a large cast of children and amateurs.

Britten's *War Requiem* (1962) is one of his finest works. It is based on the Roman Catholic Mass for the dead, blended with verses from antiwar poems by the English poet Wilfred Owen.

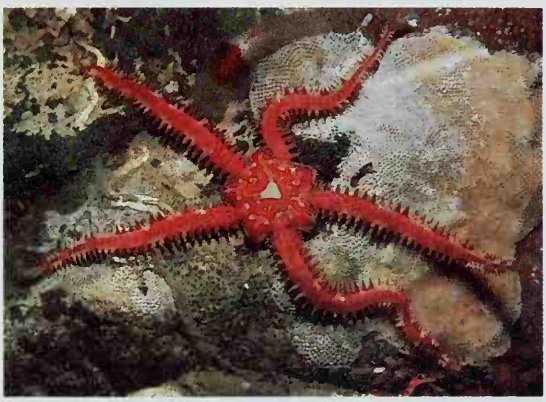
Britten skillfully combined words and music in his songs, which rank among his best works. His songs include the group *Les Illuminations* (1939) and a series of songs that begins with "Canticle I" (1947) and ends with "Canticle V" (1971). *A Ceremony of Carols* (1942) is a group of songs for women's chorus and harp with words from medieval English texts.

Edward Benjamin Britten was born in Lowestoft. He was a child prodigy and composed several works, including an oratorio and six string quartets, before he was 12 years old. Britten began studying with the English composer Frank Bridge about that age. At 17, he entered the Royal College of Music in London.

Stewart L. Ross

Brittle star is a sea animal that resembles a starfish. Large numbers of these animals live along the bottom of all the world's oceans and in shallow water near the shore. They are not often seen because they live under rocks or in cracks in coral, or they burrow in mud or sand.

Most *species* (kinds) of brittle stars have five arms. The arms are longer and more flexible than the arms of starfish. Brittle stars are sometimes called *serpent stars* because their arms resemble snakes. The brittle star is called "brittle" because it may throw off parts of its arms when it is handled or disturbed. Later, new arms grow. The animal uses its arms to bring food to the mouth, which is located in the center of the body on the underside. The mouth is the only opening into the brittle star's sacklike stomach. Unlike the arms of starfish, the arms of brittle stars do not have digestive or reproductive organs. The brittle star eats small animals that may be alive or dead.



Charles R. Seaborn

The brittle star uses its five arms for breathing, feeling, and seeking food. The kind above is found in the Caribbean Sea.

The brittle star has slender tubes called *tube feet* on the underside of its arms. It uses them to breathe, to make small movements, to sense its surroundings, and to help bring food to the mouth. Unlike starfish, brittle stars have no suction disks on their tube feet.

John C. Ferguson

Scientific classification. Brittle stars are classified in the phylum Echinodermata. They belong to the class Ophiuroidea.

See also **Echinoderm; Starfish.**

Brno, *BUR noh* (pop. 391,979), or *Brünn,* is the second largest city in the Czech Republic. Only Prague has more people. Brno ranks as the chief city of Moravia, a region that lies in the eastern part of the country. For the location of Brno, see **Czech Republic** (map).

Brno is a manufacturing center that produces automobiles, chemicals, iron and steel, leather goods, machinery, and textiles. The Czech Supreme Court meets in Brno. The Špilberk fortress stands on a hill overlooking the city. During the 1800's, the Austrian rulers who controlled the area imprisoned many of their political opponents in this fortress. Brno was founded in the 800's.

Vojtech Mastny

Broad bean is a hardy annual plant that may grow 6 feet (1.8 meters) high. It is an important food crop in Latin America. It is sometimes called the *bean of history* because it was an important food to the early civilizations of northern Africa and southwestern Asia, where it grows wild and is also cultivated.

The broad bean is also known as the *windsor bean* and the *horse bean.* Its white flowers are spotted with purple. The broad bean's pods may be 1 foot (30 centimeters) long. They contain thick beans, or seeds, that sometimes are 1 inch (2.5 centimeters) wide.

Daniel F. Austin

Scientific classification. The broad bean belongs to the pea family, Fabaceae or Leguminosae. Its scientific name is *Vicia faba.*

See also **Bean.**

Broadcasting. See **Radio; Television.**

Broadcloth is a cotton or soft woolen fabric used for making coats, suits, shirts, and dresses. Cotton broadcloth is often *mercerized* (treated with a chemical substance that gives the material a silky sheen). Wool broadcloth is woven in a *twill* (diagonal weave). It is given a heavy finish (nap) pressed lengthwise in the cloth. A process called *fulling* (shrinking) makes the wool cloth firm and close.

The term *broadcloth* was first used in England in the 1400's for cloth 54 inches (140 centimeters) or more in width. Material that measured less than this in width was known as *strait cloth.* Keith Slater

Brocade, *broh KAYD,* is a cloth that has raised designs woven into it with heavy yarns. The cloth may be cotton,

linen, silk, or wool. It may also be rayon, or other synthetic fibers. The side of the cloth meant to be seen shows the brocade pattern of colored yarn or tinsel.

Brocade designs are woven by hand or by machine into cloth to make fabrics for bedspreads, draperies, furniture coverings, and dresses. Upholstery cloth with brocade designs woven into it is called *brocatelle.*

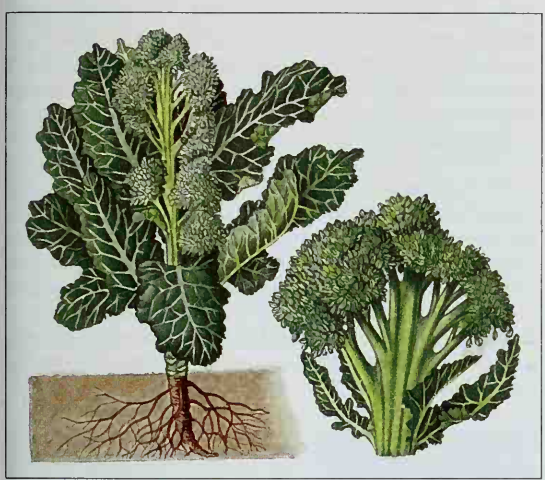
People in eastern Asia first made brocade. It became a favorite material for the clothing of European royalty and nobility in the 1200's. In the 1800's, a French weaver invented the Jacquard loom for weaving brocade. The word *brocade* comes from the French *brocher,* meaning a form of stitching. O. Frank Hunter

See also Jacquard, Joseph Marie.

Broccoli, *BRAHK uh lee,* is a nutritious garden vegetable closely related to cauliflower. Broccoli has thick clusters of flower buds that form edible "heads." Broccoli heads are green and are more branched and open than the tight, round, white heads of cauliflower.

Broccoli is rich in protein, minerals, and vitamins A and C. People cook broccoli or use it as a green, raw snack vegetable. The buds and fleshy stems are eaten.

Broccoli grows best in cool weather and in moist, fertile soil. It can be grown from seeds in 100 to 120 days.



WORLD BOOK illustration by Jill Coombs

Broccoli is a garden vegetable. The edible parts of the plant are its fleshy stems and thick clusters of green flower buds.

Some growers start the seeds in trays and then transfer the young plants to the garden for an earlier harvest. Growers harvest broccoli when the clusters of flower buds are still green. If the heads are not harvested soon enough, the buds open into bright yellow flowers.

The kind of broccoli that is commonly grown in North America is called *Italian broccoli* or *sprouting broccoli.* This broccoli originally came from southern Europe.

Scientific classification. Broccoli belongs to the mustard family, Brassicaceae or Cruciferae. Its scientific name is *Brassica oleracea.* Albert Liptay

See also Cabbage; Cauliflower.

Brock, Sir Isaac (1769-1812), was a British general who helped save Upper Canada (now Ontario) from being captured by the United States in the War of 1812. Brock led a small force of British troops, Indians, and Canadian militia against 2,000 U.S. troops who had crossed the Detroit River from Detroit in July 1812. The invaders, commanded by General William Hull, retreated to Detroit. In August, Brock attacked and captured Detroit. In October 1812, he again defeated U.S. invaders in the Battle of Queenston Heights on the Niagara River. He was killed in the battle.

Brock was born in Guernsey, an island in the English Channel. He served with British troops in Europe before arriving in Canada in 1802. He became a major general and administrator of Upper Canada in 1811.

J. M. Bumsted

Brodsky, Joseph (1940-1996), was a poet and essayist who won the 1987 Nobel Prize for literature. He was born in Leningrad in the Soviet Union (now St. Petersburg, Russia) and came to the United States in 1972. In 1991, Brodsky became the first foreign-born poet laureate of the United States.

Brodsky wrote in Russian and English. His poems deal primarily with the absence of home, the passage of time, solitude, individual memory, and close observation of everyday places and things. They are known for a musical intensity created by sounds and long sentences continuing across traditional meters and stanzas. Some of Brodsky's poems were collected in *A Part of Speech* (1980). Some of Brodsky's essays were collected in *Less Than One* (1986).

While living in the Soviet Union, Brodsky learned English so he could translate the works of the English poet John Donne. One of Brodsky's most famous poems is "Great Elegy for John Donne" (1967). In 1964, the Soviet government labeled Brodsky a social parasite for writing poetry instead of having a "useful" occupation. He was imprisoned for 18 months and in 1972 was forced to leave the country. Brodsky became a U.S. citizen in 1977.

Paul B. Diehl

Broken wind. See Heaves.

Brome is the name of about 150 kinds of grasses found mostly in the Northern Hemisphere. About 40 kinds of bromes grow in the United States. Some are used as feed for farm animals, but others are weeds.

One of the most useful bromes is *smooth brome.* This variety is native to Europe and Asia and was introduced into the United States in 1884. It grows 3 to 4 feet (0.9 to 1.2 meters) in height and is very leafy. Smooth brome is often grown with alfalfa for grazing by livestock. It also may be cut and used for later feeding. In addition, people plant smooth brome along roads and waterways because its extensive root system protects the soil against erosion. See Grass.

Another kind of brome, known as *cheatgrass,* is a troublesome weed in the rangelands and grain fields of the Western United States. It is good for grazing early in the growing season, but its quality declines rapidly as it matures. When mature, cheatgrass is difficult to control and can be a serious fire hazard.

Scientific classification. Brome is in the grass family, Poaceae or Gramineae. The scientific name for smooth brome is *Bromus inermis.* Cheatgrass is *B. tectorum.*

Douglas A. Johnson

Bromeliad, *broh MEE lee ad,* is the name for any member of a large family of tropical plants. There are about 1,500 types of bromeliads, which grow mainly in the tropical forests of the Americas. Most bromeliads,

including Spanish moss, are *epiphytes* (air plants). Epiphytes grow on other plants and take most of their moisture and food directly from the air or from decaying plant matter near their roots. Other bromeliads, such as pineapple plants, grow on the ground. Most bromeliads form tight clusters of long, sword-shaped leaves. Bromeliad epiphytes survive drought better than other epiphytes because they can hold a large amount of water in their leaf clusters. See also **Epiphyte**.

Scientific classification. Bromeliads make up the bromeliad family, Bromeliaceae. Thomas B. Croat

Bromfield, *BRAHM feeld,* **Louis** (1896-1956), was an American novelist, gentleman farmer, and political writer. He won the 1927 Pulitzer Prize for fiction for *Early Autumn* (1926), the third volume of a four-novel series called *Escape.* The other three were *The Green Bay Tree* (1924), his first novel; *Possession* (1925); and *A Good Woman* (1927). The series concerns the struggles of characters trying to escape the domination of tradition and family. His novels *The Rains Came* (1937) and *Night in Bombay* (1940) are set in India.

Bromfield was born in Mansfield, Ohio. He served as an ambulance driver in France during World War I (1914-1918). Bromfield lived in France after the war, becoming one of the most active American writers living in Paris in the 1920's. He returned to Ohio in 1939 and wrote about his experiences in farming in *Pleasant Valley* (1945) and other books. He described his conservative economic and political views in *A Few Brass Tacks* (1946). Barbara M. Perkins

Bromide, *BROH myd,* is the name for a number of compounds made with *bromine,* a dark-red liquid (see **Bromine**). *Potassium bromide* forms white crystals shaped like those of common table salt. It was formerly used to treat certain nervous disorders because of its ability to calm the nerves and ease convulsions. However, large doses of potassium bromide can cause skin rashes and mental disturbances, and it has now been replaced by safer, more effective drugs. *Silver bromide* is sensitive to light and is used to make photographic paper, photographic plates, and film. Patrice C. Bélanger

Bromine, *BROH meen* or *BROH mihn,* is a reddish liquid chemical element. Bromine is highly reactive, and it readily vaporizes into a reddish-brown gas that has a strongly irritating odor. Both the liquid and vapor forms of bromine are corrosive and poisonous. The liquid can cause severe skin burns.

Bromine is found in the form of bromide salts in salt water and dry salt beds. Commercial production of the chemical involves the treatment of salt water with chlorine to free the bromine. In the United States, the principal sources of the element are underground brines in Arkansas and Michigan.

Bromine is used in making fire-retardant chemicals and as a disinfectant in water treatment. It is also used to make *silver bromide,* a light-sensitive component of photographic materials. Other bromine compounds are used as dyes and as sedatives and anesthetics.

Through the years, bromine was widely used to make *ethylene dibromide* (EDB), which is an additive in leaded gasoline. But the use of lead-free gasoline has nearly eliminated this application of bromine. EDB has also been used as an insecticide. However, most agricultural uses of EDB have been banned because studies have shown that the compound may cause cancer.

Bromine was first prepared in 1826 almost simultaneously by Antoine J. Balard, a French chemist, and Carl J. Löwig, a German chemist. Bromine has the chemical symbol Br. It belongs to the halogen family of chemical elements. Its atomic number is 35, and its atomic weight is 79.904. Bromine freezes at −7.25 °C and boils at 59.47 °C. It is the only nonmetallic element that is liquid at room temperature. Evan H. Appelman

See also **Bromide; Halogen.**

Bronchial tube. See Bronchitis; Lung.

Bronchitis, *brahng KY tihs,* is an inflammation of the mucous lining of the air passages in the lungs. The inflammation causes these passages—called *bronchial tubes*—to increase their production of mucus, which is then coughed up. Bronchitis may be either *acute* (short-term and severe) or *chronic* (long lasting).

Symptoms of acute bronchitis include fever, chest pain, and a cough that brings up mucus. Physicians consider the condition chronic if such coughing lasts for several months in each of two or more successive years. Chronic bronchitis may produce shortness of breath and, in severe cases, heart failure. It is often associated with emphysema.

Acute bronchitis can be caused by a respiratory infection, such as a cold. It also can result from breathing irritating fumes, such as those of tobacco smoke or polluted air. The most common cause of chronic bronchitis is cigarette smoking. Either type of bronchitis may lead to asthma or pneumonia.

Bronchitis may be treated with drugs that expand the bronchial tubes, or with compounds that loosen mucus so it can be coughed up more easily. Moist air produced by a humidifier also helps loosen mucus. Antibiotics are prescribed if a bacterial infection is present. Most cases of acute bronchitis clear up within weeks. Chronic bronchitis cannot be cured. Brian J. Sproule

See also **Bronchodilator.**

Bronchodilator, *BRAHNG koh dy LAY tuhr* or *BRAHNG koh duh LAY tuhr,* is any of a group of drugs that open up the small breathing tubes in the lungs. These tubes are called *bronchioles.* Doctors prescribe bronchodilators to treat respiratory illnesses, including asthma, bronchitis, and emphysema. The drugs relax the muscles in the bronchioles, thereby expanding the tubes and making breathing easier. This can relieve such symptoms as coughing and wheezing.

Bronchodilators may be taken by mouth as a tablet, capsule, or syrup. Sometimes they are injected. But most often, they are inhaled directly into the lungs. Many patients with asthma use *metered-dose inhalers.* These devices consist of a mouthpiece and a container called a *canister.* The canister holds bronchodilators in the form of a liquid or a fine powder. While holding the mouthpiece in the mouth, the patient pushes a spring on top of the canister, releasing a certain amount of the bronchodilator. As the patient inhales, the drug enters the bronchioles.

Bronchodilators can produce several side effects. The drugs can increase the heart rate and blood pressure. They cause some patients to become restless or dizzy.

Albuterol, metaproterenol, and terbutaline are among the most widely used bronchodilators, especially by people with asthma. Another bronchodilator, theophyl-

line, was once the primary drug for treating asthma and emphysema. The bronchodilator epinephrine was frequently given by injection for severe asthma attacks in the past. Today, doctors use epinephrine injections mainly in life-threatening emergencies when the patient cannot use an inhaled drug. Alice S. Sloan

Bronchoscope is an instrument used to examine the trachea and the bronchial tubes of the lungs. A bronchoscope consists of a hollow tube with a system of lights and mirrors. The most common type of bronchoscope is the *fiber-optic bronchoscope*, a thin, flexible tube that transmits light by means of glass or plastic fibers (see **Fiber optics**).

A doctor inserts a bronchoscope through the patient's mouth or nose into the throat and lungs. It enables the physician to detect diseased areas that cannot be seen by X rays. Attachments, such as a forceps, sucking needle, and brush, can be added to a bronchoscope. Physicians use these attachments to remove small tumors, pus, foreign bodies, and samples of lung tissue.

Brian J. Sproule

Bronco is a cowhand's term for a bad-tempered or untamed horse. The word means *rough* or *wild* in Spanish. Cowhands also use the word *bronco* instead of mustang for the small, wild horses that roam the Western United States. Easterners sometimes call any untrained horse shipped from the West a bronco. The wild horses of the West are descended from horses brought by early Spanish explorers. Today, broncos are used to herd cattle and for roughriding competitions in rodeos. Broncos in rodeos are called *broncs*. See also **Rodeo**; **Remington, Frederic** (picture). Steven D. Price

Brontë sisters, *BRAHN tee,* were three sisters who became famous novelists—Charlotte (1816-1855), Emily (1818-1848), and Anne (1820-1849). Their lives and works are associated with the lonely moors of Yorkshire, England, where they were born.

Their lives. Patrick Brontë, the sisters' father, was a poor Irishman who became the parish clergyman in the small, isolated town of Haworth, Yorkshire. Brontë was somewhat eccentric and inclined to be strict. His wife died in 1821 and her sister brought up the family conscientiously, but with little affection or understanding. The sisters went to several boarding schools where they received a better education than was usual for girls at that time, but in a harsh atmosphere.

Few jobs were available for women at that time, and the Brontë sisters, except for occasional jobs as governesses or schoolteachers, lived their entire lives at home. They were shy, poor, and lonely, and occupied themselves with music, drawing, reading and—above all— writing. Their isolation led to the early development of their imaginations. In 1846, under the masculine pen names of Currer, Ellis, and Acton Bell, the sisters published a joint volume of poems. Although only two copies were sold, all three sisters soon had their first novels published.

Their works. Charlotte Brontë's famous novel *Jane Eyre* (1847) is largely autobiographical. Through the heroine, Charlotte relived the hated boarding school life and her experiences as a governess in a large house. Rochester, the hero and master of the house, is fictional. *Jane Eyre* was enormously successful, but many readers were shocked that Rochester, who tried to make Jane his mistress, should be rewarded by marrying her. Some readers were also shocked because Jane wanted to be regarded as a thinking and independent person, rather than as a weak female.

Charlotte Brontë wrote three other novels. The first one, *The Professor,* was not published until 1857, after her death. *Shirley* (1849) is set among labor riots of the early 1800's. *Villette* (1853), the most popular of the three, is based on Charlotte's unhappy experiences as a governess in Brussels.

Emily Brontë wrote only one novel, *Wuthering Heights* (1847), a romantic masterpiece. The work was not as popular as *Jane Eyre,* and was even more strongly condemned for its brutality, its lack of conventional morality, and its glorification of romantic passion. Not all readers find the supernatural elements, or the hero Heathcliff's pitiless cruelty, wholly believable. However, the author's vivid descriptions and her understanding of social class and individual temperament give even the exaggerated elements of her story impact. Her portrait of the moors reveals Emily as a poet of enduring power.

Anne Brontë was the mildest and most patient of the sisters. Both her novels, *Agnes Grey* (1847) and *The Tenant of Wildfell Hall* (1848), can be seen as less violent versions of *Jane Eyre.* Sharon Bassett

Detail of portrait of the Brontë sisters by Patrick Branwell Brontë; The National Portrait Gallery, London.

The Brontë sisters were painted by their brother Branwell. The picture shows Anne, *left,* Emily, *center,* and Charlotte, *right.*

Additional resources

Barker, Juliet. *The Brontës.* St. Martin's, 1995.
Gordon, Lyndall. *Charlotte Brontë: A Passionate Life.* Norton, 1994.
Guzzetti, Paula. *A Family Called Brontë.* Dillon Pr., 1994. Younger readers.
O'Neill, Jane. *The World of the Brontës.* Carlton Bks., 1999.

Brontosaurus. See Apatosaurus.

Bronx. See **New York City** (The city; The Bronx).

Bronze is an alloy made primarily of copper and tin. Bronze may contain as much as 25 percent tin. Phosphorus, lead, zinc, and other metals may be added for special purposes. For example, phosphorus hardens and strengthens bronze.

Because of the reputation of bronze for hardness and

Bronze Bronze is a hard, durable alloy of tin and copper. People have made objects from bronze since about 3500 B.C. Bronze articles include ornaments, sculptures, tools, vases, and weapons.

The Metropolitan Museum of New York, purchase, 1966, Fletcher Fund and the Guide Foundation, Inc. Gift

Egyptian cat
About 1085-332 B.C.

The Art Institute of Chicago, Lucy Maud Buckingham Collection

Chinese ceremonial pot
About 1122-256 B.C.

The St. Louis Art Museum

Bronze helmet, Greece
About 550-500 B.C.

Ratapoil, by Honoré Daumier; Hirshhorn Museum and Sculpture Garden, Smithsonian Institution (SCALA/Art Reference)

Modern French sculpture
1888

durability, the name has been adopted commercially for many copper alloys that contain little or no tin but are similar in color to bronze. Some excellent brass alloys have been incorrectly called bronze. However, it is usually understood that when the word *bronze* is used by itself, the alloy will contain considerable tin.

Properties and uses. The hardest and strongest bronze contains much tin and little lead. Alloys with a high tin content also have a low melting point. They are preferred for intricate ornamental castings such as statues. When bronze is to be used for this purpose, lead is often added to the alloy. The result is a cheaper alloy that is easier to cut.

Lead is also added to bronze when the manufactured article will need to be lubricated. For example, bearings are made from leaded bronze. Bronze that contains only phosphorus and tin wears best against steel when no lubricating agent is used. Because it is easily cast in large shapes, bronze is often used in making bells. It also has special sound-damping characteristics that give these bells a rich tone.

Most bronze alloys resist corrosion. Statues and bells made of bronze will weather to a beautiful brown color or develop a green *patina* (film) characteristic of copper. After such films form, bronze corrodes very slowly. Because of this, bronze articles frequently last hundreds of years.

Bronze alloys that contain as much as 10 percent tin are widely used in *wrought* form, in which the metals are hammered or beaten into shape. Or, they are first cast and afterward shaped by rolling or drawing to produce rods, wires, sheets, or tubing. When they are hardened by cold working, these alloys make excellent springs. They are commonly used where corrosion or electrical resistance make the use of steel undesirable. The electrical industry makes wide use of such bronze. Sometimes the red brasses are substituted, but they are not as satisfactory.

Silicon and aluminum bronze are more difficult to cast and fabricate than are the tin bronzes. But they are excellent copper-base alloys with special properties that make them useful. Silicon bronze is copper alloyed with 1 percent to 3 percent silicon. Then about 1 percent iron, nickel, or manganese is added. Silicon bronze has great resistance to corrosion from strong chemicals and is used for chemical containers. Aluminum bronze may contain 5 percent to 10 percent aluminum and as much as 5 percent of iron, nickel, or manganese. Some aluminum bronzes can be heat-treated and hardened until they are as strong as steel.

History. The oldest alloy known to human beings was a bronze made of copper and arsenic. People learned to make it about 3500 B.C. Gradually, people replaced the arsenic with tin. The period in history between the Stone Age and the Iron Age became known as the Bronze Age because bronze was commonly used to cast containers such as cups, urns, and vases. People also shaped bronze into battle-axes, helmets, knives, shields, and swords. They also made it into ornaments, and sometimes even into primitive stoves.

I. Melvin Bernstein

See also **Alloy; Bronze Age; Copper; Tin.**

Bronze Age was the period when people used bronze for tools and weapons. It followed the Stone Age, when stone was the chief material. When iron tools became widespread, the Bronze Age ended and the Iron Age began.

The Bronze Age is not a particular period of time. Some areas had their Bronze Age early, others had it late. In some places, it lasted for a long time, and in oth-

ers it was short. The people of some regions skipped the Bronze Age altogether.

The earliest known use of bronze occurred in Sumer, in Mesopotamia, about 3500 B.C. The Chinese began to use bronze during the Shang dynasty (about 1766 to 1122 B.C.). During this period, the use of bronze became widespread in northern China. People continued to use bronze until sometime between 1500 and 1000 B.C. Then iron, which first appeared in Asia Minor, became common. The Bronze Age in most regions overlapped an earlier Stone Age and a later Iron Age, because people did not stop using one material all at once. Some South American Indians had begun to use bronze before white explorers came. Brian M. Fagan

See also **Aegean civilization; Bronze; Stone Age.**

Bronze Star. See **Medals, decorations, and orders** (table).

Brood nest. See **Bee** (The honey bee colony).

Brook Farm was an experimental socialist community established in 1841 near West Roxbury, Massachusetts, 9 miles (14 kilometers) from Boston. Members of a philosophical movement called *Transcendentalism* founded the farm to develop a union between intellectual growth and manual labor. To achieve this goal, they operated a school on the farm. See **Transcendentalism.**

George Ripley, a literary critic and social reformer, headed Brook Farm. It functioned as a joint-stock company and was governed by about 20 resident shareholders, each of whom had one vote. All farm residents received the same wages, worked the same number of hours, and paid the same room and board. The school encouraged a free and equal relationship between students and teachers and began some other features of modern progressive education. Brook Farm was discontinued in 1847 because of rising debts. John Clendenning

See also **Alcott, Bronson.**

Brooke, Edward William (1919-), a Massachusetts Republican, served in the United States Senate from 1967 to 1979. He became the first African American elected to the Senate since the Reconstruction period after the American Civil War (1861-1865). Brooke was also the first African American elected to the Senate by popular vote. He defeated Endicott Peabody, a white Democrat and former governor of Massachusetts. The state had a heavily Democratic and 98 percent white population.

Brooke was born in Washington, D.C., and graduated from Howard University. He served in the Army in Italy during World War II and won the Bronze Star for bravery. After the war, Brooke earned a law degree from Boston University. He was elected attorney general of Massachusetts in 1962 and was reelected in 1964. As attorney general, he gained nationwide fame for exposing corruption in the Massachusetts state government. He was awarded the Spingarn Medal in 1967.

David S. Broder

Brooke, Frances (1724-1789), was an English author who wrote *The History of Emily Montague* (1769), the first novel in Canadian literature. Brooke lived in Canada from 1763 to 1768, while her husband was chaplain in the British garrison at Quebec. She set her novel primarily in Quebec. The plot is a traditional love story told in letters written among four friends in England and Quebec. The work is best known for its convincing account of life and amusements in a rugged British garrison town. It also includes interesting portrayals of the French-Canadian working class, then known as *habitants,* and the Indians.

Brooke, whose maiden name was Frances Moore, was born in Lincolnshire. In 1756, she married John Brooke, an Anglican minister. She became a noted literary figure in London, writing drama and poetry and translating French literature into English.

Rosemary Sullivan

Brooke, Leonard Leslie (1862-1940), an English portrait painter and water-colorist, is best known for his picture books. He wrote and illustrated *Johnny Crow's Garden* (1903) and its two sequels. These books are considered Brooke's most outstanding and original work. His portrayal of animal characters and his skill as an artist in line and color have given him a distinguished place in the history of books for children.

Brooke did much of his early work as an illustrator in line drawings. Among the first books he illustrated was George MacDonald's *The Light Princess* in 1890. He illustrated Mrs. Molesworth's stories from 1891 to 1897. He also illustrated *The Nursery Rhyme Book* (1897), edited by the Scottish poet Andrew Lang. His other books include *The Golden Goose Book* (1905), *Ring o' Roses* (1922), and *A Roundabout Turn* (1930), which was written by R. H. Charles. Brooke was born in Birkenhead, England. Marilyn Fain Apseloff

Brooke, Rupert (1887-1915), was an English poet whose career was cut short by his death in World War I (1914-1918). Brooke composed poems about nature and love, but he is best known for *1914,* a sequence of patriotic war sonnets published in 1915, after his death. The sonnets expressed the patriotic idealism that was the mood of England during the early years of the war. His most famous war poem is "The Soldier."

Brooke was one of the most admired of the Georgian poets of the early 1900's in England. The Georgians wrote idealistic and traditional romantic poetry about nature and the pleasures of rural living. Brooke's death became symbolic of the death of Georgian poetry.

Brooke was born in Rugby, near Coventry. He traveled in North America, Europe, and the South Pacific in 1913 and 1914. Brooke enlisted in the army shortly after war broke out. He died of blood poisoning on the Greek island of Skiros. Jerome Bump

Brookhaven National Laboratory is a center for scientific research on Long Island, New York. The laboratory conducts research in physics, chemistry, biology, medicine, and energy technology. Its major achievements include the discovery of subatomic particles, such as the J particle—also known as the psi particle— and the omega-minus. The lab was founded in 1947 and is owned by the United States Department of Energy.

Since the early 1970's, applied research has become increasingly important at the laboratory. This research ranges from the development of new industrial materials to studies of atmospheric pollutants and investigations of processes that underlie addiction and aging.

The National Synchrotron Light Source at the lab produces intense beams of X rays and ultraviolet and infrared light. Scientists use the beams to study the structure of protein crystals and other solid objects. Another Brookhaven facility, the Relativistic Heavy Ion Collider, accelerates two beams of *ions* (electrically charged

atoms) to tremendous energy. The beams travel in opposite directions around two ring-shaped tubes. The ions collide, and scientists study the tracks of objects that stream away from the collisions. By studying the tracks, the scientists learn about subatomic particles and the forces that control them.

Critically reviewed by Brookhaven National Laboratory

See also **Particle accelerator; Psi particle.**

Brookings Institution is a nonprofit organization engaged in nonpartisan study of economic, governmental, and international issues and the social sciences. Its purpose is to contribute to the understanding of important problems in public policy. It conducts research, publishes books and staff papers, and sponsors conferences and study groups. Robert S. Brookings, a St. Louis businessman, founded the institution in 1916. Its headquarters are in Washington, D.C.

Critically reviewed by the Brookings Institution

Brooklyn is one of the five *boroughs* (districts) that make up New York City. It lies at the southwest end of Long Island, across the East River from Manhattan. For location, see **New York City** (maps). Brooklyn is an important industrial center and ranks as one of the nation's leading seaports.

Brooklyn covers 71 square miles (184 square kilometers) and has 2,465,326 people. It is the most heavily populated of the five boroughs. If it were an independent city, Brooklyn would rank as the nation's fourth largest city. Its neighborhoods include Bedford Stuyvesant, which has had many African American residents; Bensonhurst, which attracted many Italian Americans; and Brighton Beach, where many Russians settled.

The Brooklyn, Manhattan, and Williamsburg bridges and the Brooklyn-Battery tunnel connect Brooklyn and Manhattan. Every day, thousands of commuters travel between the two boroughs. The Verrazano-Narrows Bridge, which is one of the longest suspension bridges in the world, links Brooklyn and Staten Island.

Brooklyn's landmarks include Prospect Park, Coney Island, the Brooklyn Museum, the Brooklyn Botanic Gardens, and the Brooklyn Academy of Music. From 1890 to 1957, Brooklyn was the home of the famous Brooklyn Dodgers major-league baseball team.

Brooklyn's industries include the preparation of pharmaceuticals, shipbuilding and ship repair, and the production of hardware, plastics, and textiles and knitwear. Hundreds of ships carry freight to and from Brooklyn's docks each year.

Canarsie Indians were the first inhabitants of Brooklyn. In the 1600's, Dutch settlers named the area for a village in Holland called Breuckelen. Brooklyn was incorporated as a city in 1834. For many years, it was primarily a residential area and was connected to Manhattan by ferries. Industries began to develop in Brooklyn during the 1800's. The population rose because of the arrival of European immigrants from 1840 to 1924.

In 1898, Brooklyn became a part of New York City. In the 1950's, large numbers of African Americans and Puerto Ricans moved there. But the borough's population declined by about 500,000 between 1950 and 1980 because many people moved to suburban areas. It increased by more than 230,000 between 1980 and 2000 as immigrants from around the world settled in Brooklyn.

Frank M. Sorrentino

See also **New York City** (Brooklyn).

Brooklyn Bridge is a suspension bridge over the East River. It connects the boroughs of Brooklyn and Manhattan in New York City. The bridge, which has a span of 1,595 feet (486 meters), was the largest suspension bridge in the world when it was completed in 1883. Its total cost was about $15 million.

Brooklyn Bridge hangs from steel cables that are nearly 16 inches (41 centimeters) thick. The cables are suspended from 275-foot (84-meter) towers and are anchored at their ends to massive blocks of masonry. The bridge has six lanes for traffic. In 1964, the National Park Service designated the bridge a national historic landmark. Fred F. Videon

Culver

The Brooklyn Bridge was hailed as the "eighth wonder of the world" when it was opened in 1883. It has a span of 1,595 feet (486 meters). John Roebling designed the bridge. When he died, his son Washington Roebling, with the help of Washington's wife, Emily Warren Roebling, directed construction work on it. Currier and Ives made this print when the great bridge was opened to traffic.

Brooks, Garth (1962-), is an American country singer and songwriter who has demonstrated crossover appeal to popular music audiences as well as to country music fans. His honky-tonk style draws large crowds from around the world, and his albums have sold millions of copies.

His first album, *Garth Brooks* (1989), included three songs that became hits on the country music charts—"If Tomorrow Never Comes," "Not Counting You," and "The Dance." His third album, *Ropin' the Wind* (1991), was the first album in history to reach the number-one position on both the country and pop charts simultaneously.

Troyal Garth Brooks was born in Tulsa, Oklahoma. He attended Oklahoma State University and majored in advertising. After graduation, he decided to pursue a career as a country singer.

Brooks has received a number of awards, including Entertainer of the Year from both the Country Music Association and the Academy of Country Music. He became a member of the Grand Ole Opry in 1990 at the age of 28. Paul F. Wells

See also **Country music** (Modern country music).

Brooks, Gwendolyn (1917-2000), was an American poet. In 1950, she became the first black American to win a Pulitzer Prize. She received the award for *Annie Allen* (1949), her second collection of poetry. The central poem is a story about the experiences of a black girl growing up in America during World War II (1939-1945).

Brooks was born in Topeka, Kansas. She grew up in the Chicago community called "Bronzeville." This area provided the setting for her first book of poems, *A Street in Bronzeville* (1945), and for a book of children's poems, *Bronzeville Boys and Girls* (1956). In her early poetry, Brooks attacked racial discrimination, praised black American heroes, and satirized both blacks and whites. Brooks's skillful use of short, rapid verse lines and seemingly casual rhymes increases the effectiveness of her biting wit. *Selected Poems* (1963) includes many of the best poems from her early writing.

The year 1968 marks a dividing line in Brooks's work. In her writings both before and after 1968, Brooks showed her commitment to racial identity and equality for blacks. However, in her earlier work, she showed great mastery of European-American poetic styles and techniques. Her later work became more militant and nationalistic. This verse is written in a style that includes black language and rituals, and places black solidarity above the demands of art for its own sake. Her later poetry is represented in *In the Mecca* (1968), *Riot* (1970), *Aloneness* (1971), *To Disembark* (1981), *The Near-Johannesburg Boy, and Other Poems* (1986), *Blacks* (1987), *Winnie* (1988), and *Children Coming Home* (1991). She published a novel, *Maud Martha* (1953), and an autobiography, *Report from Part One* (1972). Brooks was the poet laureate of Illinois. Nellie Y. McKay

Brooks, Van Wyck, *van WYK* (1886-1963), was an American writer best known for his books of literary criticism and social history. Many of Brooks's writings explore the conflict he saw in American life between art and commerce. According to Brooks, Americans traditionally have tended to emphasize commerce at the expense of art. Brooks also examined what he called a "usable past"—that is, an American literary tradition on which present-day writers could build.

His most important work is *Makers and Finders: A History of the Writer in America, 1800-1915.* This work consists of five volumes. The first volume, *The Flowering of New England, 1815-1865* (1936), won the 1937 Pulitzer Prize for history. The other volumes are *New England: Indian Summer, 1865-1915* (1940), *The World of Washington Irving* (1944), *The Times of Melville and Whitman* (1947), and *The Confident Years: 1885-1915* (1952).

Brooks was born in Plainfield, New Jersey. A selection from his published memoirs was republished after his death as *An Autobiography* (1965). Samuel Chase Coale

Broom is the name of a group of attractive shrubs that have slender, tough branches with small green leaves. People once tied the branches into a bunch and used it as a broom. There are more than 100 broom species.

The *Scotch broom,* a native of Europe, also grows in North America. Many of its branches are leafless or almost without leaves. It has yellow or white flowers, shaped like butterflies, that bloom in spring. The flowers develop into flat pods by summer. The pods explode on hot days and release many seeds. Because Scotch broom thrives even in poor soil, it has become a pesky weed that spreads rapidly. It often invades areas where other plant species grow and replaces the native plants.

Some types of broom have been used as medicines, but others are poisonous. Most species are grown by cuttings or from seed. The Plantagenet family of English rulers got its name from the Latin term *Planta genista,* which means *sprig of the broom plant.* Fred T. Davies, Jr.

Scientific classification. Scientists classify most broom plants in the pea family, Fabaceae or Leguminosae. The scientific name for the Scotch broom is *Cytisus scoparius.*

See also **Legume.**

Broom, Jacob (1752-1810), a farmer and businessman from Delaware, was a signer of the Constitution of the United States. He regularly attended sessions of the Constitutional Convention of 1787, but did not play a significant role.

Broom was born in Wilmington, Delaware. His business pursuits included banking, surveying, shipping, and the manufacture and repair of machinery. A cotton factory that he owned on the Brandywine River near Wilmington was one of the first of its kind in the United States. Broom became assistant *burgess* (legislator) of Wilmington in 1776. He was appointed chief burgess four times. Broom served in the Delaware state legislature from 1784 to 1786 and in 1788. In 1790, he became the first postmaster of Wilmington. Broom held this position until 1792. Barbara E. Benson

Broom, Robert (1866-1951), was a Scottish anatomist and paleontologist. In 1936 in South Africa, he discovered the fossil remains of an ancient humanlike creature called *Plesianthropus,* now known as *Australopithecus africanus.* He wrote about these fossils and discussed their significance in human evolution.

Broom was born in Paisley, Scotland. He received his medical degree from Glasgow University in 1889. In 1897, he moved to South Africa. Broom practiced medicine until 1928. He was also a professor of zoology and geology at Victoria College (now Stellenbosch University) from 1903 to 1934. Broom's works on paleontology include *Mammal-Like Reptiles of South Africa* (1932) and *The South African Fossil Apeman* (1946). Keith R. Benson

Brother Jonathan was a name for any patriotic

American during and after the Revolutionary War in America (1775-1783). It meant the person was especially interested in helping the cause of the country. Later, the name was used to refer to the whole nation, in much the same way that *Uncle Sam* now stands for the United States government.

There is a popular story about how the name *Brother Jonathan* originated. According to this story, the name was given by George Washington to his friend Jonathan Trumbull. Trumbull, an ardent patriot, was governor of Connecticut from 1769 to 1784. When Washington was trying to organize the Continental Army, he often asked Trumbull for help. Trumbull was in a position to supply food, ammunition, and advice. Whenever he needed advice or supplies, Washington would say, "We must ask Brother Jonathan about this subject." After he became president in 1789, Washington frequently used the expression, "Let us ask Brother Jonathan," when he had a matter to put before Congress. So the United States itself, represented by Congress, gradually took on the name *Brother Jonathan.* James H. Hutson

See also **Trumbull, Jonathan; Uncle Sam.**

Brotherhood/Sisterhood Week is observed during the third week of February. Its purpose is to further understanding among people of all cultures and religions. During Brotherhood/Sisterhood Week, people are reminded through schools, churches, synagogues, civic and fraternal organizations, the press, radio, and television to live according to the principles of fellowship, equality, and justice.

The idea of a special occasion to promote brotherhood was advanced by Hugh L. McMenamin, a Roman Catholic priest, in Denver in 1929 and was first celebrated in 1933. By the 1940's, enthusiastic response turned Brotherhood Day into Brotherhood Week. In 1978, the name was changed to Brotherhood/Sisterhood Week. It is celebrated in the United States and in other parts of the world. Brotherhood/Sisterhood Week is sponsored by the National Conference of Christians and Jews.

Critically reviewed by the National Conference of Christians and Jews

Broun, *broon,* **Heywood Campbell,** *HAY wud* (1888-1939), was one of the nation's most widely read newspaper columnists in the early 1900's. Broun began his liberal, independent column, "It Seems to Me," after joining the *New York Tribune* staff in 1912. He moved to the *New York World* in 1921 and to the *New York Telegram* in 1928. His role in organizing editorial employees into the American Newspaper Guild in 1933 made him controversial. He was born in the Brooklyn section of New York City. Joseph P. McKerns

Brown, Sir Arthur Whitten. See Alcock and Brown.

Brown, Benjamin Gratz (1826-1885), was a candidate for vice president of the United States in 1872. He and presidential candidate Horace Greeley represented both the Democratic Party and the Liberal Republicans, a group that split from the Republican Party. They lost to the Republican candidates, President Ulysses S. Grant and Henry Wilson. Brown was a Republican U.S. senator from Missouri from 1863 to 1867, filling an unexpired term. He was governor of Missouri from 1871 to 1873. Brown was born in Lexington, Kentucky. He was usually called B. Gratz Brown or Gratz Brown. James E. Sefton

Brown, Charles Brockden (1771-1810), was the first major American novelist. He also was the first American to earn a living as an author.

Brown wrote Gothic novels, a type of horror story that emphasizes mystery, terror, and the supernatural. *Wieland* (1798) tells of a man who goes insane and murders his family. In *Ormond* (1799), the heroine stabs to death a wealthy scoundrel who tries to rape her. English Gothic writers influenced Brown's style, but he placed his stories in American settings. For example, *Edgar Huntly* (1799) occurs in a forest inhabited by hostile Indians.

Most modern readers consider Brown's writing awkward and far-fetched. But his emotional intensity and early use of American settings influenced such great writers as James Fenimore Cooper, Nathaniel Hawthorne, and Edgar Allan Poe.

Brown was born in Philadelphia. During his boyhood, he spent much of his spare time reading English horror tales. Edward W. Clark

Brown, Edmund Gerald, Jr. (1938-), was governor of California from 1975 to 1983. He was elected mayor of Oakland, California, in 1998. Brown was nicknamed Jerry from his middle name. His father, Edmund G. Brown, was California's governor from 1959 to 1967.

A Democrat, Jerry Brown was first elected governor in 1974. He campaigned for the 1976 Democratic presidential nomination but lost. He was reelected governor in 1978. He ran unsuccessfully for the Democratic presidential nomination in 1980 and 1992 and for the United States Senate in 1982. In his campaigns, Brown called for strict limits on government spending and urged better conservation of natural resources.

Brown was born in San Francisco. He studied for the Roman Catholic priesthood for a time. Brown graduated from the University of California at Berkeley and earned a law degree at Yale Law School. In 1966, he joined a Los Angeles law firm. Brown was elected secretary of state of California in 1970. He was leader of the state's Democratic Party from 1989 to 1991. Richard C. Bergholz

Brown, George (1818-1880), was a Canadian journalist and politician. His newspaper, the Toronto *Globe,* became the leading reform journal in Canada. Brown also was one of the Fathers of Confederation. This group planned the union of British North American colonies that became the Dominion of Canada in 1867.

Brown was born in Alloa, Scotland, near Edinburgh. He moved to the United States in 1837, and he settled in Canada in 1843. He founded the *Globe* in 1844.

Brown served in the Legislative Assembly of the Province of Canada almost continuously from 1851 to 1867. The Assembly had equal numbers of representatives from the province's two main sections, Canada East and Canada West. Problems arose when the population of Canada West exceeded that of Canada East. Brown championed the principle of representation by population. In 1864, Brown represented the Reform Party in the push to unite the Canadian colonies. He worked closely with John A. Macdonald and George Étienne Cartier, his political rivals. Brown was appointed to the Canadian Senate in 1873. J. M. Bumsted

Brown, Harold (1927-), served as secretary of defense from 1977 to 1981 under President Jimmy Carter. Brown was the first scientist and expert on nuclear weapons to head the Department of Defense.

Brown was born in New York City. He graduated from

high school at the age of 15 and earned a Ph.D. degree in physics from Columbia University at the age of 21.

In 1950, Brown became a research scientist at the University of California in Berkeley. In 1952, the university opened what is now the Lawrence Livermore National Laboratory, a nuclear weapons design center located in Livermore, California, and Brown moved to the laboratory. There, he directed work on the Polaris missile and other weapons. Brown became head of the laboratory in 1960.

In 1961, President John F. Kennedy named Brown director of defense research and engineering. From 1965 to 1969, Brown served as secretary of the Air Force under President Lyndon B. Johnson. He then became president of the California Institute of Technology (Caltech). Brown helped arrange the 1972 SALT agreement with the Soviet Union to limit nuclear weapons.

Nancy Dickerson Whitehead

Brown, James (1933-), ranks among the most influential artists in popular music. Brown's rhythmic innovations and his tirelessly energetic concert appearances made him the leading performer in rhythm and blues or soul music. Brown's many nicknames include "the Godfather of Soul."

Brown was born in poverty in Barnwell, South Carolina, and raised in Augusta, Georgia. He shined shoes, picked cotton, and served three years in prison for breaking into automobiles from 1949 to 1952 before turning to music. His 1956 recording of "Please, Please, Please" became his first million-record seller. Brown later recorded about 100 hits, such as "Papa's Got a Brand New Bag" (1965), "Cold Sweat" (1967), and "Say It Loud, I'm Black and I'm Proud" (1968). Although the peak of his career ran from the 1960's through the early 1970's, Brown experienced a renewal of popularity in the 1980's with such hit songs as "Living in America" (1986). From 1988 to 1991, he served 2 $\frac{1}{2}$ years in prison for assault.

Don McLeese

Brown, Jesse (1944-), served as United States secretary of veterans affairs from 1993 to 1997 under President Bill Clinton. He was the first African American to serve in this Cabinet post. A disabled veteran of the Vietnam War (1957-1975), Brown spent his professional career with the Disabled American Veterans (D.A.V.) before his appointment as secretary. The D.A.V. helps disabled veterans return to an independent way of living.

Brown enlisted in the U.S. Marine Corps in 1963. In 1965, during the Vietnam War, he was wounded while patrolling the Da Nang area of South Vietnam. This injury partly paralyzed his right arm. For being wounded in combat, he earned the Purple Heart medal. Brown joined the Disabled American Veterans in 1967 in Chicago. Beginning in 1973, he held a series of executive posts with the D.A.V. in Washington, D.C. There, he gained experience working with the federal government. From 1989 to 1993, he served as executive director of the D.A.V.'s Washington, D.C., headquarters. Brown was born in Detroit.

Barbara A. Reynolds

Brown, Jim (1936-), was one of the greatest runners in National Football League (NFL) history. Brown, a fast and powerful fullback, played with the Cleveland Browns from 1957 until he retired after the 1965 season. He won the league rushing championship a record eight times and was awarded the Jim Thorpe Trophy as the NFL's Most Valuable Player in 1958, 1963, and 1965. In 1963, Brown set a single-season rushing record when he ran for 1,863 yards. O. J. Simpson of the Buffalo Bills broke that record in 1973. Brown held the NFL record for most yards gained in a career—12,312—until 1984 when it was broken by Walter Payton of the Chicago Bears. In 1971, Brown was elected to the Pro Football Hall of Fame.

James Nathaniel Brown was born in St. Simons Island, Georgia. He attended Syracuse University and won All-America honors in 1956. After retiring from football, he became a motion-picture actor. Brown wrote his autobiography, *Out of Bounds* (1989), with Steve Delsohn.

Carlton Stowers

Brown, John (1800-1859), was a radical abolitionist whose attempt to free the slaves cost a number of lives and helped indirectly to bring on the American Civil War. His ancestors had sailed to America in the early colonial period. He was born in Torrington, Connecticut, and lived as a child in Ohio. His two marriages resulted in 20 children. He did various types of work and had several business ventures. He was not a successful businessman, and his family lived insecurely.

The abolitionist. From his youth, Brown hated slavery and helped fugitive slaves to escape to Canada. He lived in Springfield, Massachusetts, from 1846 to 1849. After he left Springfield, he organized a league among blacks for their protection against slave catchers. In 1849, he moved to North Elba, New York, an area that was settled by blacks. Brown was later buried there.

In 1855, he followed five of his sons to Kansas. They settled in Osawatomie and worked to keep Kansas from becoming a slave state. In May 1856, proslavery men attacked and burned the nearby town of Lawrence. Two days later, Brown led an expedition to Pottawatomie Creek, where his men brutally murdered five proslavery settlers. A number of small but bloody battles broke out between Free State men and those who wanted slavery. Brown became famous as "Old Osawatomie Brown" after he defended Osawatomie from attack by proslavery men in 1856.

Harpers Ferry. Brown had been considering an invasion of the South, and he began to collect arms and men for that purpose in 1857. Although he was an outlaw, he received sympathy and aid. Some who helped Brown did not know his plans. His idea seems to have been to raid the United States arsenal at Harpers Ferry, Virginia (now West Virginia), and then encourage slaves to rebel (see **Harpers Ferry**).

He and 18 followers captured the arsenal on Oct. 17, 1859. But later that day, the local militia bottled up Brown with his dead, wounded, and a few prisoners in the arsenal. Colonel Robert E. Lee forced the fort open on October 18 and delivered Brown to the state for trial. Brown conducted himself bravely and intelligently. Northern efforts were made to have him de-

The Kansas State Historical Society, Topeka

John Brown

cleared insane, but he was convicted of treason and hanged on December 2. The event inspired Ralph Waldo Emerson to say that Brown would make the gallows "as glorious as a cross." Union troops, when the Civil War began, sang: "John Brown's body lies a-mouldering in the grave, His soul goes marching on." Louis Filler

See also **Kansas** ("Bleeding Kansas"); **United States, History of the** (Social disorder).

Additional resources

Cox, Clinton. *Fiery Vision: The Life and Death of John Brown.* Scholastic, 1997.

Oates, Stephen B. *To Purge This Land with Blood: A Biography of John Brown.* 2nd ed. Univ. of Mass. Pr., 1984.

Tackach, James. *The Trial of John Brown.* Lucent Bks., 1998.

Brown, Marcia Joan (1918-), an American illustrator of children's books, was the first to win the Caldecott Medal three times. She won in 1955 for *Cinderella; or The Little Glass Slipper* (1954); in 1962 for *Once a Mouse* (1961); and in 1983 for *Shadow* (1982). She has adapted and illustrated such folk tales as *Stone Soup* (1947), *Dick Whittington and His Cat* (1950), *The Three Billy Goats Gruff* (1957), and *Bun: A Tale from Russia* (1972). Brown was born on July 13, 1918, in Rochester, New York. She won the Regina Medal in 1977 and the Laura Ingalls Wilder Award in 1992. Kathryn Pierson Jennings

Brown, Robert (1773-1858), was a Scottish botanist. He was the first person to describe the general occurrence of the nucleus in living cells, and he gave it the name *nucleus.* In 1827, he described the agitation of microscopic particles that is now called *Brownian motion.* He named the world's largest flower, the *giant rafflesia* of Sumatra. This flower can grow more than 3 feet (90 centimeters) wide. Brown also began the study of plant fossils, using a microscope. Brown was born on Dec. 21, 1773, in Montrose, Scotland. He became curator at the British Museum. See also **Suspension.** Keith R. Benson

Brown, Ronald Harmon (1941-1996), became the first African American to head a major United States political party when he was elected chairman of the Democratic Party's national committee in 1989. He served as chairman until 1993, when he became secretary of the U.S. Department of Commerce under President Bill Clinton. He was the first black to serve as Commerce Department secretary. Brown died in an airplane crash in Croatia in 1996 while on department business.

Brown was born on Aug. 1, 1941, in Washington, D.C. He received a B.A. degree from Middlebury College and a law degree from St. John's University in New York. In 1967, Brown joined the National Urban League. He worked for the league first as a social worker in New York City. In 1979, when he left the organization, Brown held the league's second-highest position as director of its Washington, D.C., office. From 1979 to 1981, Brown was a top aide to U.S. Senator Edward M. Kennedy. In 1981, he became a partner in the Washington, D.C., law firm of Patton, Boggs & Blow. Brown served as deputy chairman of the Democratic Party's national committee from 1982 to 1985. Michael Barone

Brown dwarf is a dim heavenly object that has more mass than a planet but less mass than a star. Brown dwarfs are about the same size as the planet Jupiter, but they have about 10 to 75 times more mass than Jupiter. Mass is the amount of matter in an object.

Astronomers have thought since the 1970's that a large number of brown dwarfs exist but could not be certain they had found any until 1995. They had also thought that brown dwarfs might make up much of the *dark matter,* an invisible substance of unknown form. Calculations involving gravity indicate that dark matter exists. Research has shown that there are not enough brown dwarfs to make up much of it. See **Dark matter.**

Brown dwarfs are difficult to detect because they are so dim. The brightest ones glow a dull red similar to that of low-mass stars known as *red dwarfs.*

Stars and brown dwarfs form in the same way. A cloud of dust and gas shrinks under the force of gravity, and a ball forms at its center. The shrinkage produces heat. If the ball has enough mass, its core becomes so hot that hydrogen nuclei begin to *fuse* (join together), producing even more heat. The ball blazes as a star. If the ball has insufficient mass, however, so little fusion occurs that it becomes a brown dwarf. The ball glows faintly, but the fusion is so weak that it begins to cool immediately. The brown dwarf slowly fades, and fusion eventually ceases. Gibor Basri

Brown lung is a lung disease that affects many workers in cotton textile mills. The disease, also called *byssinosis,* results from inhaling the cotton dust that enters the air during processing. The dust contains fragments of *bracts*—the small leaves that surround the cotton boll—and other plant parts. Physicians believe these fragments are the main cause of brown lung.

Workers who develop brown lung first experience symptoms after months or years of exposure to cotton dust. The symptoms include shortness of breath, a feeling of tightness in the chest, and in many cases, coughing. At first, the symptoms usually occur only on the first day of work after a weekend or vacation. Later, they may last all week. Continued exposure to cotton dust may permanently damage a worker's ability to breathe, especially the ability to exhale, and result in a condition similar to chronic bronchitis (see **Bronchitis**).

Physicians diagnose brown lung from a patient's symptoms and job history and by observing a decreased ability to exhale rapidly after exposure to cotton dust. The only way to halt the progress of the disease is to end the victim's exposure to cotton dust. Contrary to its name, brown lung does not affect lung color.

The governments of the United States and many other nations have set limits on workers' exposure to cotton dust in textile mills. In some states of the United States, workers disabled by brown lung may receive workers' compensation. Michael G. Levitzky

Brown recluse, *REHK loos,* is a brownish, poisonous spider found in the United States. It is about $\frac{3}{8}$ inch (10 millimeters) long and has a dark, violin-shaped mark on its back. Unlike most spiders, the brown recluse has six eyes arranged in three groups of two instead of eight eyes arranged in two rows of four. A few hours after a brown recluse bites a person, the skin around the bite becomes red and swollen. In time, most of this tissue dies, leaving a deep sore that may take months to heal. Reactions to the bite range from mild to severe. The venom disrupts normal function of the victim's immune system. A few severe reactions to the bite cause death, usually as a result of secondary infection.

Originally, the brown recluse lived only in the south-central United States. Today, it is occasionally found in

other parts of the country. Several closely related species live in various parts of the country. These spiders look so much like the brown recluse that only a specialist can distinguish them. Some of these other species are also venomous.

WORLD BOOK illustration by John F. Eggert

Brown recluse

The brown recluse can live a long time without food or water and has probably been carried to other areas in shipping crates. It is usually found outdoors under rocks, and indoors under furniture and in undisturbed areas. Bites occur when people come into contact with clothes and other items inhabited by the spider.

The brown recluse is active at night. It spins a sticky, irregular web with threads in all directions. The brown recluse uses its poison to paralyze the insects it preys on. The insects may live for days, allowing the spider to eat at its leisure. The female brown recluse lays 30 to 90 eggs at a time and encloses them in a thin, white egg sac.

Scientific classification. The brown recluse belongs to the Loxocelidae family. Its scientific name is *Loxoceles reclusa.*

Edwin W. Minch

Brown thrasher is a songbird found east of the Rocky Mountains in southern Canada and the United States. It is noted for its beautiful song, which resembles that of its relative, the northern mockingbird. But unlike the mockingbird, the brown thrasher sings each phrase of its song twice instead of many times. It often imitates the sounds of other birds, though not as expertly as the mockingbird.

The brown thrasher measures 10 to 12 inches (25 to 30 centimeters) long. Its head, back, and long tail are reddish-brown. The bird's breast is white with brown streaks.

Most brown thrashers build their nest of twigs, leaves, and other plant materials in bushes, in brush piles, or on the ground. The female generally lays from three to five eggs, which are white or bluish-white and covered with brown spots.

The bird feeds chiefly on the ground. It helps gardeners because it eats many insects that are harmful to plants. It also eats berries, fruits, and grains. The brown thrasher is the state bird of Georgia.

Scientific classification. The brown thrasher belongs to the mockingbird and thrasher family, Mimidae. Its scientific name is *Toxostoma rufum.*

Martha Hatch Balph

See also Thrasher.

Brown University is a privately endowed coeducational school located in Providence, Rhode Island. Chartered in 1764, it is one of the oldest colleges in America. Brown University has undergraduate programs in the arts and sciences. It also has a graduate school and a medical school. The university grants bachelor's, master's, and doctor's degrees.

Brown University was founded in Warren, Rhode Island. The university moved to Providence in 1770. The present campus covers over 50 acres (20 hectares) on College Hill overlooking the city. The university's six libraries feature several famous collections.

Critically reviewed by Brown University

Brown v. Board of Education of Topeka was a case decided in 1954 in which the Supreme Court of the United States declared racial segregation in public schools to be unconstitutional. The full name of the case is *Brown et al v. Board of Education of Topeka, Shawnee County, Kansas.* The court decided the case together with several others that dealt with the same issue. The court applied its decision to all of the cases at the same time. But the name of the *Brown* case is almost always used in referring to the decision.

The Supreme Court's decision launched the legal movement to desegregate U.S. society. At that time, many areas of the United States, especially in the South, were racially segregated. In segregated areas, blacks and whites went to separate schools, lived in separate neighborhoods, rode in separate parts of buses, and drank from separate drinking fountains. State laws called *Jim Crow laws* required or permitted such separation. An 1896 Supreme Court decision in the case of *Plessy v. Ferguson* had permitted separate railroad cars or trains as long as they were equal in nature. The 1896 decision established the "separate but equal" principle, which later was used to uphold other kinds of segregation in the United States.

The National Association for the Advancement of Colored People, guided by its chief lawyer, Thurgood Marshall, decided to use the *Brown* case and its companion cases to challenge the "separate but equal" principle. In the *Brown* case itself, Oliver Brown, an African American railroad worker in Topeka, Kansas, sued the Topeka Board of Education for not allowing Linda Brown, his daughter, to attend Sumner Elementary School, an all-white school near her home. The other cases involved similar suits by black parents from other parts of the country. Marshall attacked the "separate but equal" rule by arguing that segregation harms minority students by making them feel inferior and thus interfering with their ability to learn.

In a unanimous decision, the court agreed with Marshall and declared that separate educational facilities could never be equal. Therefore, segregated schools violated the 14th Amendment to the Constitution of the United States, which requires that all citizens be treated equally.

By 1960, however, several Southern states still had no black students enrolled in public schools with white students. Some progress was made in these states later in the 1960's, after a series of civil rights protests and the passage of federal laws desegregating other public facilities. In a number of cases, courts used the principles that have been established in the *Brown* decision to require or uphold the desegregation of public facilities other than schools.

In the 1970's, courts in the United States ordered many cities to begin busing students between neighborhoods to integrate public schools. Nevertheless, many black students still attend segregated schools.

Bruce Allen Murphy

See also **Education** (Education for whom?); **Marshall, Thurgood**; **Segregation** (The beginning of change).

Browne, Charles Farrar. See Ward, Artemus.

Brownies. See Girl Scouts.

Browning, Elizabeth Barrett (1806-1861), was a famous poet of Victorian England. During her lifetime, she was more admired as a poet than was her husband, Robert Browning. Today, his reputation is much higher than hers. She is best known for her romance with Browning, and only her *Sonnets from the Portuguese,* an account of that romance, are still widely read. See **Browning, Robert.**

Detail of chalk drawing (1859) by Field Talfourd; National Portrait Gallery, London

Elizabeth Browning

Elizabeth Barrett was born in Durham. She was educated at home, and learned classic Greek, Latin, and several modern languages. Her father ruled his family harshly, but he was proud of Elizabeth's accomplishments. From an early age, Elizabeth suffered from chronic weakness in the lungs. In 1821, she injured her spine in a fall. Her condition was aggravated by the shock of her brother's drowning while both were living by the sea at Torquay, in an attempt to improve Elizabeth's health. She became, seemingly, a permanent invalid, especially after her family moved to London. Elizabeth spent most of her time in a darkened room, where she wrote poetry and many letters. Robert Browning admired her *Poems* (1844) so much that he wrote to her. They met, became engaged, and were married secretly in 1846. They soon ran off to Italy, where Elizabeth's health improved remarkably. Elizabeth's father had opposed their marriage and never forgave her. For the rest of her life, Elizabeth lived in the villa of Casa Guidi, overlooking Florence. Her son was born there in 1849.

The diction and rhythm of Elizabeth's poems have an attractive, spontaneous quality, though some may seem overly sentimental. Her best poems appear in *Sonnets from the Portuguese* (1850). These poems are not translations, but a sequence of 44 sonnets recording the growth of her love for Browning. He often called her "my little Portuguese" because of her dark complexion. The 43rd sonnet is Elizabeth's most famous poem. It begins: "How do I love thee? Let me count the ways."

Late in her life, Elizabeth composed *Aurora Leigh,* describing it as a lengthy "sort of novel-poem." It examined the life and manners of her time with a special interest in the nature of being a woman, especially a woman writer. She is also known for "Cry of the Children" (1843), an attack on the misuse of child labor in England, and *Casa Guidi Windows* (1851), which appealed for political freedom for Italy and other nations under foreign control. Frederick W. Shilstone

Additional resources

Browning, Elizabeth B. *Selected Poems.* St. Martin's, 1993.
Dennis, Barbara. *Elizabeth Barrett Browning: The Hope End Years.* Seren Bks., 1996.
Stone, Marjorie. *Elizabeth Barrett Browning.* St. Martin's, 1995.

Browning, John Moses (1855-1926), invented and designed more successful firearms than any other American. He became internationally famous for designing and inventing automatic arms, including the Browning automatic rifle, also called BAR. He made his first gun from scrap metal at the age of 13. In 1879, he received his first patent—for a single-shot rifle. From then on, he designed a series of pistols, rifles, and shotguns. The U.S. Army adopted his machine gun in 1895. Several European countries also used his firearms. Browning was born in Ogden, Utah. Merritt Roe Smith

Browning, Robert (1812-1889), was one of the greatest poets of Victorian England. Browning's works reflect his robust optimism and his faith in the value of human life. In his verse play *Pippa Passes* (1841), Browning, who held complex and sometimes changing religious beliefs, has the main character express the famous conviction that "God's in His heaven—All's right with the world!" His works also reflect his interest in psychology. He was most interested in people who lived in the past and different cultures or who were insane or unconventional.

Browning's life. Browning was born and grew up in Camberwell, a suburb of London. Browning's courtship of Elizabeth Barrett and their marriage in 1846 is one of the world's most famous romances (see **Browning, Elizabeth Barrett**). The couple lived in Italy from 1846 until Elizabeth's death in 1861. Browning then returned to London with their young son. He did not achieve recognition as a great poet until he was almost 60 years old.

Browning's poems. Browning published his first poem, *Pauline,* in 1833. He wrote many narrative poems and plays before developing his best-known style, the dramatic monologue. In his monologues, he spoke in the voice of some imaginary or historical character. The collection *Men and Women* (1855) includes many of his best monologues. His most ambitious work, *The Ring and the Book* (1868-1869), tells in 12 monologues the story of a Roman murder case of the 1600's.

Browning had a fondness for people who lived during the Renaissance. Two poems in *Men and Women,* "Fra Lippo Lippi" and "Andrea del Sarto," are about Renaissance painters. Another poem, "The Bishop Orders His Tomb at Saint Praxed's Church" portrays the dilemma of a Renaissance churchman who is caught between his Catholic faith and his love of the newly rediscovered classical literature. Most of Browning's monologues portray people at dramatic moments in their lives. By entering into the lives of so many people, he satisfied, at least partly, the desire he stated in *Pauline*—to "be all, have, see, know, taste, feel, all." Some of Browning's characters are good, and some are evil. With both, he indirectly expressed belief in the value of action, and dislike of passive behavior. In "The Statue and the Bust" (1855), the poet condemned "the unlit lamp and the ungirt loin." Browning's works also affirmed his faith that life's imperfections and strivings are only a prelude to the perfection of the afterlife. In "Andrea del Sarto," Browning wrote: "Ah,

Detail of a drawing (1859) by Field Talfourd; National Portrait Gallery, London

Robert Browning

but a man's reach should exceed his grasp,/Or what's a heaven for?" The poem insists that an artist must continually accept new challenges. This was Browning's reason for writing about constantly changing characters.

Although Browning's ideas are important in themselves, the rough verse pattern and rapid movement of his poems are just as important. These qualities show Browning's respect for physical energy and action. At its best, his verse admirably expresses a spiritual and bodily vitality. Frederick W. Shilstone

See also **Pied Piper of Hamelin.**

Additional resources

Roberts, Adam. *Robert Browning Revisited.* Twayne, 1996.
Ryals, Clyde de L. *The Life of Robert Browning.* Blackwell, 1993.

Browntail moth is a serious pest on fruit trees and shade trees in New England. The moth has a wingspread of about 1 $\frac{1}{2}$ inches (3.8 centimeters). It is pure white with a brown abdomen. Both adult and caterpillar browntail moths have threadlike structures called *hairs.* These strucutres are not true hairs, which grow only on mammals, but they resemble true hairs. Adult browntail moths fly well.

The female lays about 300 eggs in July. Caterpillars emerge from the eggs after two to three weeks and begin to eat. When small, they do much damage by eating leaves. In autumn, when only partly grown, the caterpillars spin small, tough tents of silk at the tips of twigs. They spend the winter in these tents. In spring, they emerge and begin eating again.

When fully grown, the caterpillars spin loose cocoons and change into pupae. They develop into adult moths by July. The caterpillars are brown, mixed with orange to whitish, and have two bright spots on their backs. Many of their hairs, as well as some hairs of the female moths, irritate human skin and cause a rash. Because the wind may blow great quantities of the hairs about, they can be a serious problem.

The number of browntail moths has decreased as a result of control measures by people, the attacks of parasites, and cold winter weather. The insects can be destroyed by removing and burning the tents in winter. Other control measures are the same as for the gypsy moth (see **Gypsy moth**). Bernd Heinrich

Lacz Lemoine, Natural History Photographic Agency

Caterpillars of the browntail moth spin small, tough tents of silk in tree branches in autumn. They spend the winter in the tents. People destroy the pesty insects by burning the tents.

Scientific classification. The browntail moth belongs to the tussock moth family, Lymantriidae. Its scientific name is *Euproctis chrysorrhea.*

See also **Caterpillar; Moth; Tussock moth.**

Brubeck, Dave (1920-), is an American pianist and composer. Brubeck's forceful, harmonically intricate, and rhythmically complex piano style and diverse compositions reflect his early studies with the classical composers Darius Milhaud and Arnold Schoenberg. In 1951, Brubeck founded a quartet featuring Paul Desmond, an alto saxophonist. The group toured and recorded until 1967. It introduced such Brubeck compositions as "In Your Own Sweet Way," "The Duke," and "Blue Rondo a la Turk," as well as Desmond's "Take Five." The quartet became famous for its "cool" sound, classical precision, and rhythmic experimentation.

David Warren Brubeck was born on Dec. 6, 1920, in Concord, California. His most ambitious compositions include *The Light in the Wilderness* (1968), an oratorio; and *The Gates of Justice* (1969), a cantata. He often performs in a quartet with his three sons. Gary Giddins

See also **Jazz** (picture).

Bruce, Blanche Kelso (1841-1898), became the first African American to serve a full term in the United States Senate. He served as a Republican senator from Mississippi from 1875 to 1881. Hiram Revels, the nation's first black senator, had completed an unfinished term in 1870 and 1871. In the Senate, Bruce took special interest in civil rights for American Indians, blacks, and Chinese immigrants.

Culver

Blanche Kelso Bruce

Bruce, whose mother was a slave, was born on March 1, 1841, near Farmville, Virginia. He spent his childhood in slavery and was educated by tutors. Shortly after the Civil War began in 1861, Bruce escaped to Kansas, a free state. He founded a school for blacks in Lawrence, Kansas, and another in Hannibal, Missouri. Before becoming a senator, Bruce held various local offices in Mississippi. He was register of the U.S. Treasury from 1881 to 1885 and in 1897 to 1898. Nancy J. Weiss

See also **Revels, Hiram Rhodes.**

Bruce, Sir David (1855-1931), a British military surgeon and parasitologist, specialized in the study of tropical diseases. In 1886, he discovered the bacillus that causes *undulant fever,* a disease now commonly known as *brucellosis* (see **Brucellosis**). Later, in Africa, Bruce showed that sleeping sickness was transmitted by the tsetse fly. Bruce was born on May 29, 1855, in Melbourne, Australia. He studied medicine in Edinburgh and worked in Berlin at the laboratory of the German physician and bacteriologist Robert Koch (see **Koch, Robert**). Kenneth R. Manning

Bruce, Robert (1274-1329) was a Scottish king who spent most of his reign trying to free his kingdom from English rule. Ultimately, Robert Bruce succeeded against both England and political opponents within Scotland.

In a famous lawsuit of 1292, King Edward I of England awarded the throne of Scotland to John Balliol over the claims of several other men. One of these men was Robert's grandfather. Nevertheless, Edward continued to treat Scotland as a feudal possession. In 1296, the Scottish people revolted, and Edward brought his forces against them. Despite having lost the lawsuit, the Bruce family sought throughout the war with England to protect the cause of Scottish independence.

In 1306, Robert killed one of his chief rivals for the royal title, John Comyn, called the "Red Comyn." Robert took the throne of Scotland as King Robert I, but soon thereafter the English defeated him in battle. He disbanded his army, went into hiding, and began to plan new tactics against the English enemy.

The next spring, Robert landed in Carrick and defeated the English. By 1309, he had gained control of most of Scotland. He then began raiding and looting England. The English invaded Scotland again in 1314, but Robert's forces defeated them in the famous Battle of Bannockburn. In 1328, England's King Edward III recognized Scotland's independence and Robert as its king.

A famous story by the Scottish writer Sir Walter Scott reports that Robert learned persistence watching a spider try to anchor its thread. The spider failed six times but succeeded on the seventh try. Most historians doubt that the story is true. Cynthia J. Neville

See also **Bannockburn, Battle of; Edward I; Scotland** (Fight for independence).

Brucellosis, *BROO suh LOH sihs,* is an infectious disease that occurs worldwide in both human beings and animals. It is caused by bacteria called *Brucella.* Symptoms of brucellosis include fever, discomfort, weakness, and weight loss. The disease is also known as *undulant fever* and *Malta fever.*

Cattle, goats, and hogs are the principal carriers of brucellosis among domestic animals. Sheep, guinea pigs, chickens, dogs, and horses are less common sources. Brucellosis also occurs in many wild animals, including bison, buffaloes, caribou, chamois, deer, elk, foxes, moose, and reindeer.

Human beings can develop brucellosis either by consuming dairy products contaminated by *Brucella* or by working with or around infected animals or their raw meat. The disease is common among slaughterhouse workers, veterinarians, ranchers, and farmers. The bacteria enter the body through the skin or the mouth. Slaughterhouse workers may inhale airborne bacteria.

Brucellosis in humans is best prevented by controlling the disease in animals. The disease has been significantly reduced in cattle by vaccinating calves and by killing infected adult animals. Pasteurization has greatly reduced the number of brucellosis cases caused by contaminated milk. About 90 per cent of human brucellosis cases in the United States are caused by direct contact with infected animals, usually in slaughterhouses.

Doctors effectively treat human brucellosis with any of several antibiotics, including rifampin, tetracycline, and streptomycin. However, many patients suffer relapses. In addition, a patient may have the disease for months or years before proper diagnosis and treatment are established. Paul W. Wright

Bruch, *bruk,* **Max** (1838-1920), was a German composer. He wrote almost 100 compositions in a variety of forms, but only a small number are generally performed today. These include the first of three violin concertos (in G minor, final version 1868); the *Scottish Fantasy* for violin and orchestra (1880); and *Kol Nidrei* (1881), a work for cello and orchestra. Bruch, who was Jewish, based the work on melodies from a Jewish worship service. Bruch's other works include three operas; many songs and choral works; and music for orchestra, keyboard, and chamber groups. Bruch lived into the 1900's, but his style remained a product of the 1800's—romantic, easily understood, and influenced by folk music.

Bruch was born in Cologne. By age 11, he was composing chamber music and orchestral works. For much of his life, he was a composer, conductor, and teacher in Cologne, Breslau, and other German cities; and in Liverpool, England. He was a music composition professor at the Berlin Academy from 1891 to 1910. Stewart L. Ross

Bruckner, *BRUK nuhr,* **Anton** (1824-1896), was an Austrian composer of the romantic period. Bruckner was admired in his time as an organist and church composer. Today, he is recognized more for his nine symphonies. He began composing them in 1865. They show the influence of the music of Richard Wagner.

Bruckner had a unique style. His music is highly repetitive and his symphonies are very long. Deeply religious, he felt he was composing them to the glory of God. Symphony No. 7 (1884) and the unfinished Symphony No. 9 (three movements composed from 1891 to 1894) are the most appreciated of his symphonies today.

Bruckner was born in Ansfelden. From 1855 to 1861 he took extensive training in the musical technique known as *counterpoint.* Until 1861, Bruckner worked as a schoolmaster and organist. He moved to Vienna in 1868. From that year until 1891, he taught theory and organ at the Vienna Conservatory. Joscelyn Godwin

Bruegel, *BROY guhl,* **Pieter,** *PEE tuhr,* **the Elder** (1525?-1569), was an important Flemish painter. He painted religious subjects and scenes of everyday life, and he created designs for engravings.

Some of Bruegel's paintings are highly detailed works that show large numbers of peasants engaged in festive activities. These paintings include *The Peasant Dance* (about 1566), *The Wedding Feast* (about 1566), and *The Wedding Dance* (1566). Other paintings present panoramic views of landscapes filled with peasants engaged in many different activities. Examples include *The Battle Between Carnival and Lent* (1559), *The Netherlandish Proverbs* (1559), and *Children's Games* (1560). These brightly colored paintings portray many descriptive details of life and dress in Bruegel's day. The peasants portrayed are anonymous, stocky, sometimes coarse figures. Such paintings reflect the influence of proverbs and parables in which the peasants' activities symbolize the folly Bruegel saw in humanity in general. Some of the works demonstrate a moral about the behavior of human beings. Others appear to make gentle, sometimes humorous observations about human nature.

Bruegel's *Triumph of Death* (about 1562) is an example of a painting with a moral. It shows an army of skeletons swarming over a war-torn landscape, killing people and dragging them to hell. The scene provides a chilling vision of mass destruction. Bruegel may have been commenting on the religious wars that were then taking place, or warning people to reform before facing death.

Oil painting on oak panel (1560); Kunsthistorisches Museum, Vienna

Pieter Bruegel the Elder painted *Children's Games* against the background of a Flemish town.

This painting may also have been influenced by the pessimistic images of the Dutch painter Hieronymus Bosch.

In 1565, Bruegel completed a series of paintings that portray the seasons. Five of these paintings still exist. They show peasants working in beautiful landscape backgrounds of fields, hills, mountains, and rivers that stretch to the horizon. Bruegel carefully portrayed both the activities of the peasants and the particular characteristics of nature during each season. The peasants appear united with nature as elements in the life cycle. One of the series, *The Fall of Icarus,* is reproduced in the **Painting** article.

Bruegel was born in either the Netherlands or Belgium. During his lifetime, he became famous largely through engravings made from his works. Bruegel had two sons, Jan the Elder and Pieter the Younger, who became noted painters. Linda Stone-Ferrier

See also **Painting** (The northern Renaissance); **Tower of Babel** (picture).

Bruges, *BROO jihz* or *broozh* (pop. 116,724), is a picturesque city in Belgium. Its name in Flemish is Brugge (pronounced *BROOG uh*). The city lies 55 miles (89 kilometers) northwest of Brussels (see **Belgium** [political map]). The city's most important products include lace, textiles, and metals. Breweries, distilleries, shipyards, and tourism provide work for many of the people of Bruges.

The name of this ancient town means *city of bridges.* Many bridges cross the network of canals flowing through Bruges. Buildings dating back to the Middle Ages, and beautiful carvings and paintings in these buildings, attract visitors to the city. The Market Hall, which was built in the 1200's, has a bell tower with 48 bells. The city's Gothic town hall was built in the 1300's.

Bruges was founded in 865. From 1240 to 1426, Bruges was one of the most important cities in all Europe. It traded with the Hanseatic League (see **Hanseatic League**) and Venice. Aristide R. Zolberg

See also **City** (picture: Cities in Flanders).

Bruhn, *broon,* **Erik** (1928-1986), a Danish ballet dancer, was rated by many people to be the best male dancer of his time. His dancing combined strict classical form with vivid dramatic characterization, elegance, and remarkable purity of style. His greatest roles included the male leads in *Giselle, La Sylphide, Miss Julie, Night Shadow, Les Sylphides, Swan Lake,* and the great classic *pas de deux* (dances for two persons).

Bruhn was born in Copenhagen. He was trained at the school of the Royal Danish Ballet and became a leading dancer with the company. He danced with many companies throughout the world, including the New York City Ballet and the American Ballet Theatre. He retired as a performer of leading roles in 1972, but resumed his career in 1975 to dance character parts. Bruhn served as director of the Royal Swedish Ballet from 1967 to 1973. He settled in Canada in 1975 and became director of the

National Ballet of Canada in 1983. In this position, Bruhn's vision centered on the development of a new Canadian choreography. Dorothy Lourdou

Bruise is an injury to the skin and underlying tissues that produces bleeding under the skin. A bruise is also called a *contusion*. Most bruises are caused by a sudden blow that compresses or crushes the soft tissues, such as the skin and muscles. A severe blow can penetrate to the bone and cause a *bone bruise*.

Bruises are often painful and are accompanied by swelling and tissue discoloration. Tissue discoloration occurs as a result of blood seeping from injured blood vessels to the surface layers of the skin. As the bruise heals, the blood breaks down to pigments that are gradually absorbed into the bloodstream, changing the colors of the bruise. Ice packs applied to the skin immediately after the injury occurs can help relieve pain and inflammation and can help control bleeding. Bruises that restrict movement should be seen by a physician.

Critically reviewed by the American Red Cross

Brulé, *broo LAY,* **Étienne,** *ay TYEHN* (1592?-1633), a noted French adventurer, was the first European to reach Lake Ontario. He arrived there in 1615 while on a mission for Samuel de Champlain, a French explorer who founded the Canadian city of Quebec. Brulé may have been the first European to see Lakes Erie, Huron, and Superior.

Brulé was born in Champigny, France, near Paris. He probably came to Quebec with Champlain in 1608. In 1610, Champlain sent Brulé to live among the Algonquin Indians and learn their language and way of life. Brulé returned the next year and later visited the Huron Indians near Lake Huron.

During his mission for Champlain in 1615, Brulé also explored the area along the Susquehanna River, possibly as far south as Chesapeake Bay. About 1621, Brulé set out to find copper mines that the Indians had described to him. He may have reached the western shores of Lake Superior and, later, the area along Lake Erie. In 1629, an English fleet seized Quebec. Brulé deserted Champlain and fled to the Huron country. The Huron later murdered Brulé. Cornelius J. Jaenen

Brummell, *BRUHM uhl,* **George Bryan** (1778-1840), also known as Beau Brummell, was an Englishman who became famous for his fashionable lifestyle. He set styles for men's clothes and manners for 20 years. Brummell studied at Eton College, where he attracted the attention of the Prince of Wales, later King George IV. The prince made him an officer in his own regiment, the Tenth Hussars. After a few months at Oxford University, Brummell was left moderately wealthy by the death of his father. He then set up elegant bachelor quarters in London and won the admiration of the fashionable world. But his gambling and extravagant living soon plunged him into debt. Brummell fled to France to escape his creditors in 1816. In 1830, he became consul in Caen, France. He was jailed for debt in 1835. He died in France while in a mental institution. He was born in London. James J. Sack

Brunei, *BROO ny* or *BROO nay,* is a small country in Southeast Asia. It lies on the north coast of the island of Borneo. The people of Brunei enjoy a high standard of living, mainly because of the country's valuable offshore petroleum deposits. Brunei covers 2,226 square miles (5,765 square kilometers) and has a population of about 340,000. Its official name is Negara Brunei Darussalam, which means State of Brunei, Abode of Peace. Bandar Seri Begawan is its capital and largest city.

Brunei was a British protectorate from 1888 to 1984, when it became an independent nation. The basic unit of money is the Brunei dollar. For a picture of Brunei's flag, see **Flag** (Flags of Asia and the Pacific).

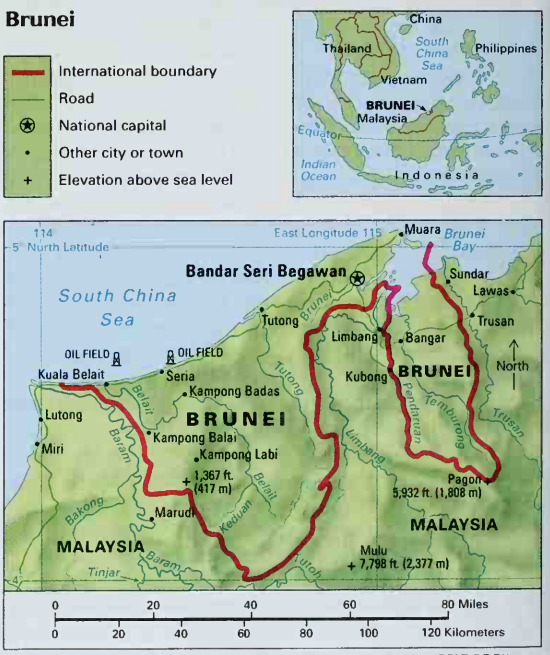
Government. Brunei's government is headed by a monarch called a sultan. The sultan is chosen for life by a council of succession. Sultan Haji Hassanal Bolkiah, who has been the ruler since 1967, also serves as the country's prime minister and minister of defense. Several members of his family hold high positions in the government. Various advisory and legislative councils assist the sultan in operating the government. The sultan appoints council members. Brunei has one political party, the Brunei Solidarity National Party.

Brunei is divided into four administrative districts for purposes of local government. Each has a district council. The sultan appoints the council members.

Brunei's highest court is the Supreme Court. It consists of a chief justice and several commissioners, who are appointed by the sultan.

People. About 67 percent of Brunei's people live in urban areas, and about 33 percent in rural areas. About two-thirds of the people are Malays. Chinese, the largest minority, make up about 15 percent of the population. The Dusun, Murut, and other native groups make up about 6 percent. Most Bruneians speak Malay, the official language. But English and Chinese are also used. Nearly all the Malays are Muslims. Most of the Chinese and many members of the native groups are Christians. A small percentage of the Chinese are Buddhists.

Most Bruneians in urban areas wear clothing similar to that worn by people in Western nations. But many Muslim women wear an outfit consisting of a long skirt,



WORLD BOOK maps

a long-sleeved blouse, and a head covering called a tudung. In rural areas, many men and women wear loose shirts and *sarongs,* which are long pieces of cloth worn as a skirt and tied at the waist. Many people in the cities live in modern houses or apartment buildings made of brick or stone. Most houses in the rural areas are wooden and have thatched roofs.

Bruneians enjoy a high standard of living. There is relatively little unemployment. The government provides free schooling, free medical services, and other benefits.

Most Bruneian children complete elementary school and many go on to high school. The country's only university is the University of Brunei Darussalam. Brunei also has teachers colleges and vocational schools.

Land and climate. Brunei borders the South China Sea on the north. The rest of Brunei is surrounded by Malaysia. Most of it is flat, and the interior is heavily wooded. The Brunei River flows through the capital.

Brunei has a tropical climate with average monthly temperatures of about 80 °F (27 °C). Rainfall averages about 100 inches (250 centimeters) a year along the coast and about 125 inches (320 centimeters) inland.

Economy. Crude oil, petroleum products, and liquefied natural gas are the major exports of Brunei. Experts predict that, based on current reserves, Brunei's petroleum supplies will run out by about 2020 and its natural gas supplies by about 2040. Concern about the heavy reliance on these products has led the government to take steps to find other sources of revenue. For example, the government has made some efforts to promote agriculture, fishing, forestry, and tourism. A more promising development has been the investment abroad of money from the country's highly profitable oil and natural gas industry. The government hopes that these investments will result in greatly increased revenues from rents, corporate dividends, and other sources to replace the eventual lost earnings from oil and natural gas.

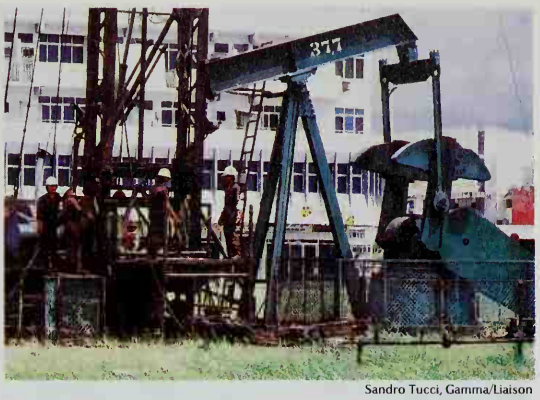
About a fourth of the labor force works for the government, the nation's largest employer. The petroleum and gas industry employs only about 5 percent of the country's labor force.

Brunei's chief trading partners include Japan, the United States, and the countries of the Association of Southeast Asian Nations (ASEAN). Brunei also belongs to ASEAN, which is a regional organization that promotes economic, cultural, and social cooperation among its members. See **Association of Southeast Asian Nations.**

History. Archaeological evidence found near Brunei's capital indicates that people have lived in the area since about the A.D. 600's. The area is first mentioned by Chinese sources in the 800's. By the 1100's, Brunei had become a major trading kingdom.

After the fall of the trading port of Malay Melaka to the Portuguese in 1511, many Malays fled to Brunei. There, they became the basis of an influential trading community. During the 1500's and 1600's, Brunei's kingdom expanded throughout the island of Borneo and through parts of the southern and central Philippines to as far north as Manila. After the Spaniards arrived in the area in 1565, they removed Bruneian rulers from most of the Philippines, but they failed to conquer Brunei itself. Throughout the 1700's, vessels from Brunei attacked Spanish shipping and settlements in the Philippines.

Following the arrival of the British in the 1800's, Brunei gradually lost its land to British interests until it was left with only a small piece of territory split in two by the state of Sarawak. In 1888, Brunei became a British protectorate. On Jan. 1, 1984, it became a fully independent nation. Leonard Y. Andaya



Sandro Tucci, Gamma/Liaison

Brunei's petroleum industry is the basis of the country's economy. These workers are operating a petroleum pumping station in Seria, a town on Brunei's coast.

Brunel, *broo NEHL,* **Isambard Kingdom,** *IHZ uhm BAHRD* (1806-1859), was an English engineer. He became famous for his skillful construction of railroads, bridges, and steamships.

Brunel was born in Portsmouth. He was the son of Sir Marc Isambard Brunel, a well-known civil engineer, and began his work with his father building a tunnel below the River Thames in London. In 1833, Isambard Brunel was appointed engineer of the Great Western Railway, which was to link London and Bristol. He supervised the design and construction of the railway system's network of tracks, bridges, tunnels, and stations. He later helped build railroads in several other countries.

In 1837, Brunel launched the *Great Western*—the first of his three huge steamships. This vessel was one of the first steamships designed for regular Atlantic crossings. Brunel's *Great Britain,* launched in 1843, was the first propeller-driven iron steamship. Brunel's most famous ship, the *Great Eastern,* was launched in 1858. It was larger than all previous vessels and displayed brilliant engineering features. But its size made it extremely difficult and expensive to operate.

Brunel designed a number of famous bridges. They include the Clifton Suspension Bridge over the River Avon in Bristol and the Royal Albert Bridge over the River Tamar in Saltash, near Plymouth. Both are still used today. J. P. Hartman

See also **Ship** (Ships of iron).

Brunelleschi, *BROON uh LEHS kee,* **Filippo,** *fih LIHP oh* (1377?-1446), was the first important architect of the Italian Renaissance. He developed techniques for lifting construction materials into position and for creating domes. Brunelleschi designed and supervised the raising of the dome over the Cathedral of Florence. For a picture of the dome, see **Architecture** (Renaissance). Brunelleschi's study of classical Roman architecture influenced his many noted buildings in Florence. They include the church of Santo Spirito and the Pazzi Chapel.

Brunelleschi was born in Florence. He began his ca-

SCALA/Art Resource

A Brunelleschi design for the interior of the church of Santo Spirito reflects the influence of classical architecture in its Corinthian columns and its geometric balance and harmony.

reer as a goldsmith. Brunelleschi's interest in mathematics led to his invention of *linear perspective,* a mathematical system for showing depth on a flat surface.

J. William Rudd

See also **Renaissance** (The fine arts; pictures: The Pazzi Chapel).

Brunhild, *BROON hihld,* is a mythical heroine who appears in German legends dating from the A.D. 400's. The legends were not written until the 1100's, when they appeared in Iceland and southern Germany. The oldest story is Scandinavian, told in the verse of the *Poetic Edda* and the prose of the *Volsunga Saga.* In this version, Sigurd rescues Brunhild from a magic sleep imposed by Odin. Later, he marries Gudrun and helps her brother, Gunnar, win Brunhild. When Brunhild discovers this treachery, she has Sigurd killed.

A different version is found in the German *Nibelungenlied.* German composer Richard Wagner's operatic treatment of her, as Brünnhilde in the *Ring of the Nibelung,* builds on the Scandinavian version. Brunhild's name is also spelled *Brynhild* (pronounced *BRIHN hihld*). C. Scott Littleton

See also **Edda; Nibelungenlied.**

Bruno, Giordano (1548-1600), was one of the most prominent philosophers of the Renaissance. His thought is a combination of philosophy, religion, mysticism, and magic. Bruno wrote poems, treatises, and dialogues. He developed a concept of "heroic love"—an ideal love of God accompanied by suffering of heroic proportions because of our separation from God during our earthly lives.

Bruno was born in Nola, Italy, near Naples. At the age of 18, he joined the Dominicans, a Roman Catholic religious order. His restless spirit and critical mind led him to question church teachings and to leave the Dominicans. Bruno traveled through northern Italy working as a tutor. He then went to Geneva, Switzerland, where he converted to Calvinism for a short time. Later, he went to France and England and then to Germany, where he briefly converted to Lutheranism. Bruno's tendency to criticize established philosophies and religions brought him into conflict with his powerful patrons and church leaders. In 1600, he was sentenced to death as a heretic by a court of the Inquisition (see **Inquisition**). He was burned alive in Rome. Ivan Soll

Brunswick was the name of a distinguished German family descended from the Welf family (see **Guelphs and Ghibellines**). The German spelling of the name is *Braunschweig.* The present line of British monarchs is descended from a branch of Brunswick dukes that lived in Hanover, Germany, called the Brunswick-Lüneburg branch.

The House of Brunswick was founded in the early 1200's by William, son of Henry the Lion, Duke of Saxony and Bavaria. The lands of Brunswick and Lüneburg were combined into a single *duchy* (territory) in 1235, when Otto the Child, a son of William, became the first Duke of Brunswick and Lüneburg. The title of Duke of Brunswick was later used by the ruling Brunswick-Wolfenbüttel branch after the Brunswick-Lüneburg branch assumed the more prestigious title of electors of Hanover in 1708.

In 1714, Elector George Louis of Hanover succeeded to the throne of Britain as George I. He was the cousin and closest Protestant relative of Britain's Queen Anne, who died that year. British law prohibited a Roman Catholic from being the nation's monarch. The Brunswick-Wolfenbüttel branch ruled the Duchy of Brunswick until 1884. Prussian regents governed it from 1885 to 1913, when Duke Ernest Augustus, a descendant of the Brunswick-Lüneburg branch, was allowed to rule. He gave up this position in 1918. Charles W. Ingrao

Brush is a device with hair, bristle, wire, or fiber set in a handle or in a round hub that attaches to a power tool. Commonly used brushes include hairbrushes, toothbrushes, and paintbrushes.

Most brush handles are made of wood, metal, or plastic. Hairs come from horses, camels, badgers, and other animals. Bristles come from pigs, and wires are made chiefly of steel. Artificial bristles are made of nylon or other plastics. Brushes are also made of such natural fibers as tampico and palmetto. Artemus Woodward manufactured the first brushes in the United States in Medfield, Massachusetts, in 1808. Robert G. Clifton

See also **Paint** (Applying the paint).

Brussels (pop. 134,856) is the capital of Belgium. For the location of Brussels, see **Belgium** (political map). Brussels ranks as the nation's fifth largest city, but it and its suburbs make up the country's largest metropolitan area. Brussels is a center of international economic and political activity. Several international organizations, including the European Union and the North Atlantic Treaty Organization (NATO), have headquarters in or near the city.

Metropolitan Brussels is officially a *bilingual* (two-language) area. Both Dutch and French, the two official languages of Belgium, are used for education and public communication. However, French is the everyday language of most of the people. The city is called *Brussel* in Dutch and *Bruxelles* in French.

The city is heart-shaped, with the oldest section, called the *lower city,* in the center. The lower city in-

Hubertun Kanus, Shostal

Brussels, the capital of Belgium, has many buildings hundreds of years old. Those shown on the main square above were built in the 1600's to house craft and merchant guilds.

cludes the Grand' Place, the main square of Brussels. The square is bordered by elaborately decorated buildings constructed during the 1600's to house merchant and craft *guilds* (associations). Brussels' town hall, which dates from the 1400's, also faces the square. East of the lower city is the *upper city,* which has many important buildings erected during the 1800's and early 1900's. It includes the royal palace, the parliament and other government buildings, and elegant residential neighborhoods. Modern neighborhoods and suburbs also surround the upper and lower cities.

The Free University of Brussels is actually two institutions, one for French-speaking students and the other for those who speak Dutch. Cultural attractions in Brussels include the Museum of Fine Arts, the Museum of Modern Art, the Museum of Natural History, and the Albert I Library. The Théâtre de la Monnaie offers performances of operas and ballets.

Economy. Brussels is the center of Belgium's banking, insurance, and transportation industries. Many of its people work for the government or for agencies of the European Union. Products of Brussels include ceramics, chemicals, drugs, processed foods, paper, and textiles. Brussels is a crossroads on the European railroad and highway networks, and an international airport serves the city.

History. Historians do not know when Brussels was founded. By the A.D. 900's, however, the city had become an important stopping point on trade routes linking western Germany and northern France. For centuries, Brussels was part of empires controlled by foreign rulers, including the Burgundians, Spaniards, Austrians, French, and Dutch. It became the capital of Belgium when the country gained independence in 1830. German troops occupied Brussels during World War I (1914-1918) and again during World War II (1939-1945), but the city suffered little damage either time.

Relations between Dutch-speaking and French-speaking Belgians have been tense throughout Belgium since the late 1800's. The bitterness increased after World War II (see **Belgium** [History]). From 1967 to 1971, Belgium changed its constitution in an effort to deal with the country's language problem. The revised constitution made the Brussels metropolitan area a bilingual area. The constitution also divided Belgium into three economic regions, of which metropolitan Brussels is one. Aristide R. Zolberg

See also **Architecture** (picture: The Palais Stoclet); **Belgium** (picture).

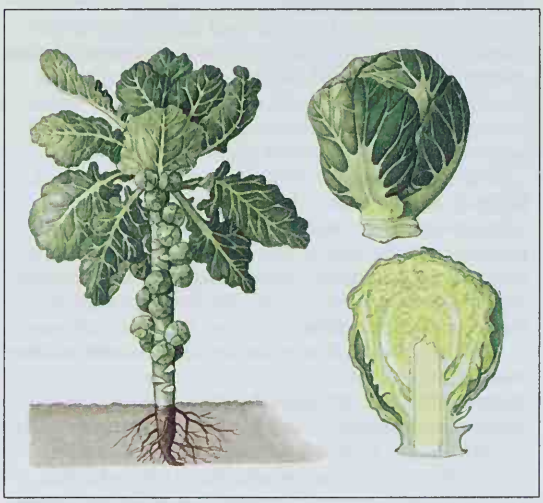
Brussels griffon, *GRIHF uhn,* is one of the breeds of small dogs that are classed as toy dogs. Some Brussels griffons have rough, wiry coats. Others have smooth coats. Those with smooth coats are sometimes called Brabançons. The Brussels griffon may be reddish-brown, black with reddish-brown markings, or solid black. Most weigh from 8 to 10 pounds (3.6 to 4.5 kilograms) and stand about 10 to 12 inches (25 to 30 centimeters) high at the shoulder.

The rough-coated Brussels griffon was developed by crossing a toy dog of Brussels, Belgium, with certain varieties of English toy spaniels. Brabançons were developed by crossing the rough-coated dog with the pug, also a toy dog. The Brussels griffon is affectionate, playful, and intelligent, and makes a fine companion.

Critically reviewed by the American Brussels Griffon Association

See also **Dog** (picture: Toy dogs); **Toy dog.**

Brussels sprouts is a vegetable with a flavor like that of mild cabbage. It is related to cabbage and cauliflower, and is cooked for food. The plant sends up a tall stalk along which the sprouts grow in the *axils* at the base of the leaves. The earliest sprouts form near the ground. Later in the season, others appear farther up the stalk. Each sprout looks like a tiny head of cabbage.



WORLD BOOK illustration by Jill Coombs

Brussels sprouts is a garden vegetable. The sprouts, which resemble small heads of cabbage, grow along the plant's stalk.

Some hybrid plants have been produced that have more uniformly developed sprouts to allow them to be harvested more efficiently.

Brussels sprouts are a good source of vitamins A, B, and C. The sprouts have the same food value as cabbage does. However, they are more expensive than cabbage.

People gather the sprouts by snapping or twisting them off the stalk. Several harvests can be made in succession from one plant. The plants do best where the growing season is long and cool.

Scientific classification. Brussels sprouts belong to the mustard family, Brassicaceae or Cruciferae. They are *Brassica oleracea,* variety *gemmifera.* Hugh C. Price

See also **Cabbage.**

Brut, *broot,* was the great-grandson of Aeneas, the mythical Trojan hero and ancestor of the Roman people. *Brut* is the French form of the Roman name *Brutus.* According to legend, Brut settled in what is now London with a band of companions and became the first king of Britain. The story of Brut was first told in the *History of the Kings of Britain,* written in the 1100's by the Welsh historian Geoffrey of Monmouth. The name *Brut* was used in the title of several adaptations of Geoffrey's work. One well-known version is *Roman de Brut* (1155), a verse chronicle by the Norman poet Wace. The English priest Layamon used it as a source for his English version, *Brut* (about 1205). Robert Francis Cook

See also **Geoffrey of Monmouth.**

Brutus, *BROO tuhs,* **Marcus Junius,** *MAHR kuhs JOON yuhs* (85?-42 B.C.), was a Roman statesman and general who helped assassinate the Roman dictator Julius Caesar. Although he and Caesar were friends, Brutus opposed Caesar's dictatorship. Brutus took part in the assassination so republican government could be restored.

Brutus was probably born in Rome. In about 48 B.C., he joined Pompey, a political rival of Caesar's, in fighting the emperor during a civil war. Pompey was defeated and killed. Caesar pardoned Brutus and appointed him governor of Cisalpine Gaul (now northern Italy) and urban *praetor* (court administrator).

Brutus was persuaded by the Roman general Gaius Cassius Longinus to help him lead the attempt to kill Caesar. On March 15 in 44 B.C., Brutus and over 20 other men stabbed Caesar to death as he entered a Roman Senate meeting. The Senate regained its power and soon sent Brutus to the eastern part of the Roman Empire, where he filled several government posts.

In 43 B.C., an alliance of three powerful Romans—Octavian (later Augustus), Mark Antony, and Marcus Lepidus—took over the government and established a new dictatorship. Brutus helped raise an army to fight them. The two opposing forces met at Philippi, in what is now northern Greece, in 42 B.C. Brutus' army was defeated, and he committed suicide. William G. Sinnigen

See also **Antony, Mark; Caesar, Julius; Cassius Longinus, Gaius; Philippi.**

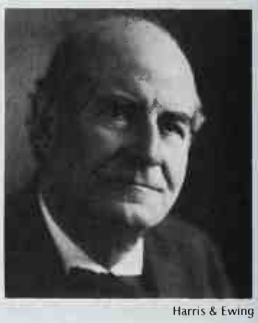
Bryan, Charles Wayland (1867-1945), was the Democratic candidate for Vice President of the United States in 1924. He and presidential candidate John W. Davis lost to their Republican opponents, President Calvin Coolidge and Charles G. Dawes. He was the brother of William Jennings Bryan, a noted lawyer and Democratic Party leader.

Bryan was born in Salem, Ill. In 1891, he moved to Nebraska, where William was active in politics. William hired him in 1896 as his financial and political adviser. From 1901 to 1923, Charles also managed and edited *The Commoner,* a newspaper William had founded in Lincoln. Charles's social concerns won him great respect in Nebraska. He served as governor there from 1923 to 1925 and from 1931 to 1935. Kendrick A. Clements

Bryan, William Jennings (1860-1925), was a noted orator and statesman. A Democrat, he ran unsuccessfully for President of the United States three times. Bryan championed popular causes and was proud of his nickname, "The Commoner."

Early career. Bryan was born in Salem, Ill., and graduated from Illinois College in Jacksonville and the Union College of Law in Chicago. He practiced law in Jacksonville for four years. In 1887, he moved to Lincoln, Nebr. From 1891 to 1895, he served Nebraska in the U.S. House of Representatives, where he opposed the gold standard and urged the free coinage of silver (see **Free silver; Gold standard**). Bryan ran unsuccessfully for U.S. senator in 1894. He then became editor of the *Omaha World-Herald* and lectured on the money question.

As a delegate to the Democratic National Convention in Chicago in 1896, Bryan wrote the free-silver plank of the platform. During the debate that followed, he delivered what is probably the most famous speech ever made before an American political convention. In a dramatic conclusion, Bryan said: "Having behind us the producing masses of this nation and the world, supported by the commercial interests, the laboring interests, and the toilers everywhere, we will answer their demand for a gold standard by saying to them: You shall not press down upon the brow of labor this crown of thorns, you shall not crucify mankind upon a cross of gold." Bryan's leadership of the silver forces led to his nomination for the presidency, though he was only 36 years old.



Harris & Ewing

William Jennings Bryan

Democratic Party leader. During the presidential campaign, Bryan made over 600 speeches in 27 states. Conservative Easterners became alarmed that he might win, and they provided huge campaign funds for William McKinley, the Republican candidate. McKinley favored the gold standard. Although Bryan carried the South and most of the states west of the Mississippi River, McKinley won.

In 1900, Bryan was again the Democratic candidate. He based his campaign largely on opposition to American annexation of the Philippines, but McKinley won by a larger majority than before. In 1908, Bryan ran for the third time, but lost to William Howard Taft.

Despite his election defeats, Bryan had a great deal of influence within the Democratic Party. Under his leadership, the party worked to solve national problems caused by the rise of big business and the growth of cities. Reforms championed by Bryan included the estab-

lishment of an income tax, voting rights for women, direct election of U.S. senators, and government regulation of business practices. From 1901 to 1923, Bryan published *The Commoner,* a newspaper in which he expressed his views.

Later years. After Woodrow Wilson became president in 1913, he appointed Bryan secretary of state. In this post, Bryan helped Wilson carry out domestic reforms. Bryan also negotiated 30 treaties that required nations to investigate international disputes before going to war. The U.S. Senate ratified all but two of these treaties, but they have never been used.

Bryan resigned as secretary of state in 1915 because he feared that Wilson's strong protests against Germany's sinking of the *Lusitania* might involve the United States in World War I (1914-1918). Bryan thought the United States should remain neutral. But when the country finally went to war against Germany in 1917, Bryan loyally supported the military effort. At the end of the war, he called for the United States to join Wilson's proposed League of Nations.

Bryan moved to Miami, Florida, in 1920. He continued to be one of the most popular lecturers in the United States. Bryan strongly supported the literal interpretation of the Bible and prohibition of the liquor trade.

Bryan's religious fundamentalism involved him in the famous trial of John Scopes, a schoolteacher who had been arrested and charged with teaching evolution in a Tennessee public school, contrary to state law. Bryan assisted the prosecution against Clarence Darrow, a famous lawyer who defended Scopes. Bryan won the case, but he died in Dayton, Tennessee, while resting after the trial. A statue of Bryan represents Nebraska in Statuary Hall in the U.S. Capitol.

Bryan wrote many articles and speeches on economic, political, and religious topics. His books include *The First Battle: A Story of the Campaign of 1896* (1896) and *The Memoirs of William Jennings Bryan* (1925), completed by his wife, Mary Baird Bryan, after Bryan's death.

Kendrick A. Clements

See also **Darrow, Clarence S.; McKinley, William; Owen, Ruth Bryan; Scopes trial; Wilson, Woodrow.**

Additional resources

Cherny, Robert W. *A Righteous Cause: The Life of William Jennings Bryan.* 1985. Reprint. Univ. of Okla. Pr., 1994.
Coletta, Paolo E. *William Jennings Bryan.* 3 vols. Univ. of Neb. Pr., 1964-1969. The definitive biography.

Bryant, Kobe, *KOH bee* (1978-), is one of the most exciting players in the National Basketball Association (NBA). Bryant, who stands 6 feet 7 inches (201 centimeters) tall, plays guard for the Los Angeles Lakers.

Bryant and Lakers center Shaquille O'Neal form one of the most dominant offensive and defensive combinations in the NBA. Bryant's athletic skills and acrobatic shots near the basket have excited crowds throughout the NBA. He won the 1997 NBA slam dunk title. Bryant is one of the league's finest all-around players. He was named to the NBA all-defensive team for the 1999-2000 season when the Lakers won the NBA championship.

Bryant is one of the few players in NBA history to succeed in professional basketball without first attending college. Bryant was drafted directly out of high school by the Charlotte Hornets in the 1996 NBA draft. He was the youngest player ever drafted in the NBA. Charlotte selected Bryant as the 13th pick and then traded his rights to Los Angeles for center Vlade Divac.

Bryant was born in Philadelphia. His father, Joe Bryant, played in the NBA from 1975 through 1983. Sam Smith

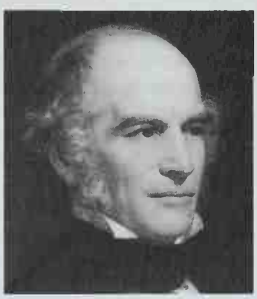
Bryant, Paul (1913-1983), was one of the top coaches in the history of American college football. During his 38 years as a head coach, Bryant's teams won 323 games, while losing only 85 and tying 7. Bryant achieved his greatest success at the University of Alabama, where he coached from 1958 to 1982. The Associated Press named his teams national champions in 1961, 1964, 1965, 1978, and 1979. Bryant, nicknamed "Bear," was a large man with a gruff manner. He was a strict disciplinarian with his players, but he also took an active interest in their lives outside of football.

Paul William Bryant was born in Moro Bottom, Arkansas, near Fordyce. He played football at the University of Alabama from 1933 to 1935. His head coaching career began in 1945 at the University of Maryland. In 1946, he moved to the University of Kentucky. He coached there eight years. Bryant coached at Texas A&M University from 1954 until he became coach at Alabama.

Bob Carroll

Bryant, William Cullen (1794-1878), was the first great American poet. He was also one of the most influential newspaper editors of his time and played a leading role in public affairs for almost 50 years.

Bryant's poems are noted for their dignified style, exact descriptions of nature, and appeal to the emotions. The English Romantic poet William Wordsworth had the greatest influence on Bryant's style and thought. Like Wordsworth and other Romantic poets, Bryant described landscapes and found moral and spiritual significance in nature. Bryant also wrote essays on poetry that are among the earliest examples of literary criticism in American literature.



Oil portrait (1850) by Henry Peters Gray, courtesy of the New York Historical Society

William Cullen Bryant

His early works. Bryant was born in Cummington, Massachusetts. He first had a poem published at the age of 13. This poem, "The Embargo," ridicules the policies of President Thomas Jefferson.

In 1811, Bryant wrote a major part of his most famous poem, "Thanatopsis." This poem is a meditation on the meaning of death. Bryant's father submitted "Thanatopsis" and another of his son's poems to the *North American Review,* a Boston magazine. At first, the editors refused to believe that any American could have written such brilliant verses. The magazine published "Thanatopsis" in 1817, and the poem quickly established Bryant as a leading poet. In 1821, Bryant added an introduction and also a final stanza, which begins with the line, "So live, that when thy summons comes. ..."

Bryant wrote most of his best poetry before 1840. In "To a Waterfowl" (1818), the poet watches a bird in flight and is reminded that both he and the bird are under the

care of God. "A Forest Hymn" (1825) begins by declaring that "The groves were God's first temples." In "The Prairies" (1833), Bryant wrote about the westward expansion of the United States to the Mississippi River and beyond.

His later career. By 1825, Bryant had become recognized as America's finest poet. He left Massachusetts and became coeditor of a magazine in New York City. In 1826, Bryant joined the *Evening Post,* a New York City daily newspaper. He served as its editor from 1829 until his death. Bryant's busy schedule left him less time for poetry. Bryant expressed his regret in the poem "I Cannot Forget with What Fervid Devotion" (1826).

Bryant became active in national affairs and in the civic life of New York City. He made the *Evening Post* a leading voice of the Democratic Party. In his editorials, Bryant supported free speech and upheld the rights of organized labor. He helped establish Central Park and the Metropolitan Museum of Art in New York City.

In the late 1840's, Bryant became an outspoken opponent of slavery. He left the Democrats and joined the Republican Party during the 1850's because the Republicans opposed slavery. Clark Griffith

See also **February** (Quotations).

Additional resources

Brown, Charles H. *William Cullen Bryant.* Scribner, 1971. A standard biography.

Bryant, William C., II, and Voss, T. G., eds. *The Letters of William Cullen Bryant.* 6 vols. Fordham Univ. Pr., 1975-1993.

Bryce, James (1838-1922), was a British historian and statesman. He is most famous for his book *The American Commonwealth* (1888), which has long been regarded as one of the finest studies of American political and social institutions. Many of Bryce's descriptions are based on observations he made during trips to the United States. Bryce wrote many other books, including *The Holy Roman Empire* (1864), *Studies in Contemporary Biography* (1903), and *Modern Democracies* (1921).

Bryce was born in Belfast, Ireland (now Northern Ireland). He graduated from Trinity College of Oxford University in 1862 and became a lawyer. Bryce became regius professor of civil law at Oxford in 1870.

Bryce was elected to the British Parliament in 1880 and served as a member of the Liberal Party in the House of Commons until December 1906. From 1907 to 1913, he served as British ambassador to the United States. In 1914, he became Viscount Bryce of Dechmont and a member of the British House of Lords. In that same year, he was appointed British representative to the Permanent Court of Arbitration, an international court at The Hague in the Netherlands.

Joseph Martin Hernon, Jr.

Bryce Canyon National Park, which lies in southern Utah, contains some of the world's most oddly shaped and beautifully colored rocks. It covers part of the Grand Canyon Region of the Colorado Plateau. It was named for Ebenezer Bryce, a pioneer who settled in the region in 1875. See **Utah** (picture).

Water and ice have worn the canyon rocks into odd shapes in more than 60 shades of red, pink, copper, and cream. The bright colors change with the sunlight. Geologists say that 60 million years of history of the earth's crust can be read in the rocks.

The park contains a series of valleys that are as much as 1,000 feet (300 meters) deep in some places. Rocks rise up into the shapes of spires, temples, cathedrals, castles, mountains, and wild animals. Bryce Natural Bridge spans a ravine at the south end of the park.

Bryce Canyon National Park was established in 1928. For the area of the park, see **National Park System** (table: National parks).

Critically reviewed by the National Park Service

Bryde's whale, *BRIHD ihs,* is a long, slender whale that lives in tropical and subtropical seas. It is not found in waters colder than 59 °F (15 °C). A Bryde's whale may reach about 45 feet (14 meters) in length. It is dark gray in color, with three prominent ridges on its head.

A Bryde's whale has bristly plates called *baleen* hanging from both sides of its upper jaw. The whales use the baleen to strain food from the water. Their prey consists mainly of squid and small fish. Bryde's whales feed by lunging open-mouthed into large masses of prey. They then force the water out of their mouth through the baleen, trapping the food inside. They often dive deep for food.

Bryde's whales are usually found alone or in small groups. Populations that live primarily in subtropical waters appear to migrate toward higher latitudes in summer and toward the equator to breed in winter. Bryde's whales that live in tropical waters apparently do not migrate. The Bryde's whale has not been as extensively hunted as other whale species. It is not considered endangered. Bernd Würsig

Scientific classification. The Bryde's whale belongs to the family Balaenopteridae in the suborder Mysticeti, order Cetacea. Its scientific name is *Balaenoptera edeni.*

Brynhild. See **Brunhild.**

Bryophyte, *BRY uh fyt,* is any of the group of small, nonflowering green plants made up of mosses, liverworts, and hornworts. Bryophytes have simple stems and leaves or grow as a flat ribbonlike *thallus.* Threadlike structures called *rhizoids* act as roots. Bryophytes may have been the first land plants. Fossils of bryophytes date from about 400 million years ago.

Bryophytes lack *conducting cells* to transport food and water. All parts of the plant can absorb water and nutrients directly from the environment. Most bryophytes live in moist places, either near streams and ponds or in areas of high rainfall. But some live in desertlike places. Except in very wet areas, bryophytes usually are less than 2 inches (5 centimeters) tall.

Bryophytes reproduce by spores rather than seeds. Two forms of the plant occur in the life cycle, the *gametophyte* and the *sporophyte.* In bryophytes, the sporophyte is attached to the gametophyte. Bryophytes also can reproduce if any part of the plant breaks off. These parts can grow into new plants. David H. Wagner

See also **Hornwort; Liverwort; Moss; Peat moss; Spore.**

Bryozoan, *BRY uh ZOH uhn,* is a type of water animal that lives only in colonies. Bryozoans are *invertebrates* (animals without backbones). There are approximately 5,000 species of bryozoans. They are found throughout the world in many water habitats, from shallow ponds to the deepest oceans. Colonies of freshwater bryozoans may form large, jellylike masses, or they may form delicate, branchlike networks on water plants. Marine bryozoan colonies may resemble seaweed. They also may

Heather Angel

A colony of marine bryozoans forms a lacy network on a branch of coral. Bryozoan colonies consist of microscopic individuals that attach to one another.

form lacy, hard-shelled or mosslike crusts or mounds on rocks, pilings, or other solid surfaces. Bryozoans are also called *moss animals.*

A bryozoan colony consists of microscopic, connected individuals called *zooids.* Each bryozoan zooid has a boxlike or tube-shaped body that contains fluid and a U-shaped gut. A cluster of tentacles called a *lophophore* extends into the water to trap small particles of food. Bryozoan fossils date from 500 million years ago.

Judith E. Winston

Scientific classification. Bryozoans are members of the phylum Ectoprocta or Bryozoa. There are three classes of bryozoans: Gymnolaemata, Phylactolaemata, and Stenolaemata.

Brzezinski, *breh ZIHN skih,* **Zbigniew Kazimierz,** *zuh BIHG nehf kah ZHEE myehz* (1928-), was a key aide of United States President Jimmy Carter. He served as assistant to the president for national security affairs from 1977 to 1981. Brzezinski acted as Carter's chief adviser on defense and as head of the National Security Council, the highest defense planning group in the government. In 1978, he helped establish diplomatic relations between the United States and China.

Brzezinski was born in Warsaw, Poland, and moved to Canada with his family in 1938. He received B.A. and M.A. degrees from McGill University and, in 1953, earned a Ph.D. degree from Harvard University.

From 1953 until 1960, Brzezinski taught political science at Harvard. During that time, he wrote extensively on Soviet Communism. In 1960, Brzezinski joined the faculty of Columbia University. From 1973 to 1976, Brzezinski served as director of the Trilateral Commission, a private group that promotes cooperation between the United States, Japan, and the countries of Western Europe. Lee Thornton

B.T.U. See British thermal unit.

Bubble chamber. See Particle accelerator; Particle detector.

Bubble gum is a form of chewing gum. The *gum base* (chewy portion) of bubble gum is firm and elastic so that chewers can blow bubbles without popping the gum. Like chewing gum, most bubble gums consist of five basic ingredients—the gum base, sugar or another sweetener, corn syrup, softeners, and flavorings. Some bubble gum packages contain comics, stickers, or picture cards. See also Chewing gum. Joan Weber

Buber, *BOO buhr,* **Martin** (1878-1965), was one of the greatest Jewish philosophers of modern times. Buber was an adherent of *Zionism,* a movement which believes that the Jews are a people and should have a state. He was also a leading interpreter of the Jewish mystical movement called *Hasidism.*

Buber's philosophy begins with the relationship between the human being and the world. Buber believed that there are two kinds of relationships: (1) between "I and you," and (2) between "I and it." The "I and you" relationship is direct, mutual, and open. The "I and it" relationship is imperfect and impersonal. In the "I and you" relationship, both sides speak as equals. God is the "Eternal You" and the relationship of a human being to God is the supreme relationship of "I and you." Through this relationship, the human being gains *revelation,* or the knowledge of God's will. Buber's philosophy is deeply rooted in Judaism. But Protestant and Roman Catholic thinkers have been influenced by his concept of the life of faith as a life of dialogue between God and human beings.

Buber was born in Vienna, Austria, and taught Judaism in Germany. When the Nazis came to power in 1933, he was forced to resign his university professorship. In 1938, he moved to Palestine, where he taught at the Hebrew University. Buber wrote several books, including *I and Thou* (1923) and *Tales of the Hasidim* (1961).

Lawrence H. Schiffman

Bubonic plague. See Plague.

Buchan, *BUHK uhn,* **John** (1875-1940), a British diplomat and author, served as governor general of Canada from 1935 to 1940. He traveled widely throughout Canada and encouraged Canadians to stress national unity over their regional differences. Buchan also supported the development of independent Canadian policies in world affairs and worked to strengthen ties between the United States and Canada. In addition, Buchan was a popular writer. In 1937, he agreed to the founding of the Governor General's Literary Award, Canada's highest literary honor.

Buchan was born in Perth, Scotland. He attended the universities of Glasgow and Oxford and, from 1927 to 1935, served in the British Parliament. In 1935, he was named first Baron Tweedsmuir of Elsfield.

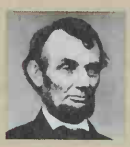
Buchan wrote about 65 books. His output included several outstanding historical works and biographies, such as *A History of the Great War* (1921-1922), *Julius Caesar* (1932), *Sir Walter Scott* (1932), and *Oliver Cromwell* (1934). Buchan also wrote many novels of adventure, intrigue, and romance. His thriller *The Thirty-Nine Steps* (1915) was made into a movie by Alfred Hitchcock, a famous motion-picture director and producer. *Memory Hold-the-Door* (1940), an autobiography, was completed just before his death. Jacques Monet

James Buchanan

15th President of the United States 1857-1861

Pierce
14th President
1853-1857
Democrat

Buchanan
15th President
1857-1861
Democrat



Lincoln
16th President
1861-1865
Republican, Union

Oil painting on canvas (1859) by George Peter Alexander Healy; Corcoran Gallery of Art, Washington, D.C.

John C. Breckinridge
Vice President
1857-1861

Buchanan, *byoo KAN uhn,* **James** (1791-1868), served as President in the critical years just before the Civil War. Many issues divided the nation, but slavery was the main cause of argument. Buchanan personally opposed slavery. But, as President, he insisted that the Constitution protected slavery and that the laws must be obeyed.

When 7 of the 15 slave states seceded in 1860-61, Buchanan refused to use force to hold them in the Union. He hoped they would grow discouraged and return to the Union. He felt that a warlike policy might cause all the slave states to secede, making a peaceful settlement impossible. His policy delayed the Civil War until after his successor, Abraham Lincoln, took office.

The only President who never married, Buchanan was almost 66 years old when he succeeded his fellow Democrat, Franklin Pierce. The public respected him for his faithful service in both houses of Congress, as Secretary of State, and in important diplomatic posts. People found him reserved at first meeting, but warm and friendly when they knew him better. His nephew described him as "tall—over six feet, broad shouldered, with a portly, dignified bearing . . .; his eyes were blue, intelligent, and kindly, with the peculiarity that one was far and the other near sighted, which resulted in a slight habitual inclination of the head to one side. . . ."

The storm over slavery gathered during Buchanan's Administration. Abolitionist authors aroused New England. The Lincoln-Douglas debates in Illinois focused attention on the moral wrongness of slavery. Adding to the national unrest, wild speculation in western land and railroads brought on an economic panic. Many banks, factories, and railroads failed. Thousands of unemployed workers stood in bread lines for free food.

On the brighter side, women wore lavish outfits with hoop skirts, and beaver hats trimmed with ostrich feathers. Pony express riders carried the mail through the expanding West. Queen Victoria sent greetings to Buchanan over the first Atlantic cable. In winter, Americans went riding in horse-drawn sleighs and sang a new tune called "Jingle Bells."

Early life

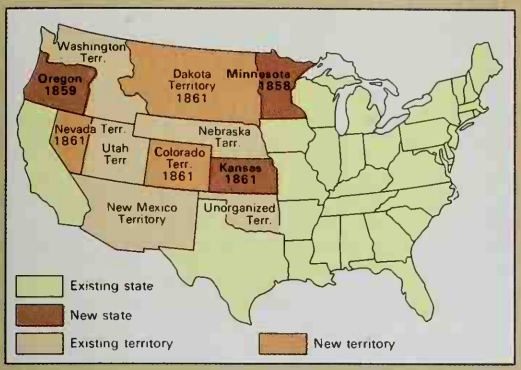
James Buchanan was born on April 23, 1791, in a log cabin in Stony Batter, near Mercersburg, Pa. His father, James Buchanan, Sr., had come from Ireland in 1783 at the invitation of an uncle living near Gettysburg, Pa. He married Elizabeth Speer, a neighbor of his uncle, and opened a country store.

Young James, the second of 11 children, learned arithmetic and bookkeeping while working at his father's store. The boy studied Greek and Latin under the village pastor. He attended Dickinson College in Carlisle, Pa., and was expelled for breaking the rules. But he returned to take high scholastic honors.

After graduation in 1809, Buchanan studied law in Lancaster, Pa. He began to practice law there in 1812. His careful business habits enabled him to build a fortune which at his death totaled $300,000.

Political and public career

Soldier and legislator. Buchanan supported the Federalist Party, which favored a strong central government. Like most Federalists, he opposed a second war with Britain. But when the War of 1812 came, he volunteered as a private to help defend Baltimore. He served in the Pennsylvania legislature for two terms, from 1814 to 1816.



Three new states—Minnesota, Oregon, and Kansas—joined the Union during Buchanan's Administration. In 1861, Congress created the Colorado, Dakota, and Nevada territories.

The U.S. flag had 33 stars when Buchanan left office. A star had not yet been added for Kansas, which joined the Union in 1861.

The world of President Buchanan

The Supreme Court's Dred Scott Decision, announced on March 6, 1857, denied U.S. citizenship rights to all blacks and stated that Congress could not prohibit slavery.
The first passenger elevator was installed in 1857 in a New York City department store by inventor Elisha G. Otis.
The first transatlantic telegraph cable was laid in 1858 between Newfoundland and Ireland.
The Lincoln-Douglas debates in Illinois attracted national attention from August to October 1858. Abraham Lincoln and Stephen A. Douglas, candidates for the U.S. Senate, debated the extension of slavery into free territories.
The Comstock Lode, a huge deposit of silver and gold discovered in 1859, drew thousands of prospectors to western Nevada.
The first oil well in the United States began pumping oil near Titusville, Pa., in 1859.
Abolitionist John Brown captured the U.S. arsenal at Harpers Ferry, Va. (now W. Va.) on Oct. 17, 1859. Brown, who planned to encourage slave revolts in the South, was eventually convicted of treason and hanged.
Charles Darwin's theories of evolution appeared in his controversial book, *The Origin of Species* (1859).
The pony express mail delivery service operated in 1860 and 1861 between St. Joseph, Mo., and Sacramento, Calif.
The Confederate States of America was formed on Feb. 4, 1861, by representatives of Alabama, Florida, Georgia, Louisiana, Mississippi, and South Carolina. Five other states later seceded and joined the Confederacy.

WORLD BOOK map

Tragedy. Buchanan retired from politics in 1816 and returned to his law practice in Lancaster. A personal tragedy turned his path back toward public service. He had fallen in love with Ann Coleman, the daughter of an iron manufacturer in Lancaster. They became engaged in 1819. After a misunderstanding, Ann went to Philadelphia to stay with a married sister. She died there. Gossips hinted that she had committed suicide, although there was never any proof of this. Buchanan carried his grief throughout his life. Partly to get away from the scene of his romance, he returned to politics.

Congressman and diplomat. Buchanan ran successfully for the United States House of Representatives in 1820. During his 10 years of service there, he broke with the dying Federalist Party. In 1824, he supported the presidential candidacy of Andrew Jackson, a hero of the War of 1812. He continued his support even after Jackson was defeated by John Quincy Adams. Jackson was elected President in 1828. He appointed Buchanan minister to Russia in 1831 as a reward for his loyal support. Buchanan, a man of simple tastes, did not enjoy the formalities of the court of Czar Nicholas I. But he achieved results. In 1832, Buchanan negotiated the first trade treaty between the United States and Russia.

Important dates in Buchanan's life

1791	(April 23) Born near Mercersburg, Pa.
1820	Elected to the U.S. House of Representatives.
1831	Appointed minister to Russia.
1834	Elected to the United States Senate.
1845	Appointed secretary of state.
1853	Appointed minister to Great Britain.
1856	Elected President of the United States.
1868	(June 1) Died in Lancaster, Pa.

Senator. Buchanan sailed home in November 1833. In December 1834, the Pennsylvania legislature elected him to fill a vacancy in the United States Senate. He served there until 1845. Buchanan became one of Jackson's leading supporters, and served for a time as chairman of the committee on foreign affairs. He tried to quiet the angry debates over slavery, declaring that laws could not change the moral beliefs of the people.

In 1844, Buchanan's supporters in Pennsylvania mentioned him as a "favorite son" candidate for the Democratic presidential nomination. Buchanan withdrew his name before the convention met. Democrat James K. Polk won the election, and offered Buchanan the post of secretary of state. Buchanan accepted, and resigned from the Senate in 1845.

Robert Katz, The Mercersburg Academy

Buchanan was born in Stony Batter, Pa., a pioneer settlement near Mercersburg. His log cabin birthplace was later moved and now stands on the campus of The Mercersburg Academy.

Secretary of state. While Buchanan was secretary of state, the country acquired much new territory. As one of his first tasks, he completed the steps needed to make Texas a state. This angered Mexico, which had never recognized Texan independence. Negotiations for a peaceful settlement failed, and the Mexican War resulted (see **Mexican War**). After the war, the United States acquired the entire Southwest.

At this time, the United States and Great Britain jointly occupied the Oregon region. President Polk claimed that the United States should have the entire region. Buchanan steered negotiations with the British, and eventually agreed to a compromise line that forms the present Canadian boundary. See **Polk, James Knox** ("Oregon fever").

Minister to Great Britain. The Whig Party regained the presidency in 1849, and Buchanan retired to Wheatland, his estate in Lancaster, Pa. In 1852, he ran for the Democratic presidential nomination. But Franklin Pierce won the nomination and the election. He appointed Buchanan minister to Great Britain.

In London, Buchanan tried for two years to modify the Clayton-Bulwer Treaty of 1850. This treaty provided that neither nation should occupy territory in Central America. After the treaty had been signed, the British claimed that it did not affect possessions they already held. The Americans replied that they would not have ratified the treaty if they had known this. Buchanan tried to get the British to give up these possessions, but failed. See **Clayton-Bulwer Treaty.**

While in Europe, Buchanan also helped write the Ostend Manifesto of 1854. This document recommended that the United States should offer to purchase Cuba from Spain. It warned the Spaniards that the island might be seized if disorders ever threatened peace in the United States. Americans condemned the manifesto after newspapers reported, not quite correctly, that Buchanan had advised the President to seize Cuba if Spain would not sell it. See **Ostend Manifesto.**

Election of 1856. Many leading Democrats became unpopular as presidential candidates because they had supported the Kansas-Nebraska Act in 1854 (see **Kansas-Nebraska Act**). But Buchanan had been in London when Congress passed this bill, and had taken no stand on it. He returned from Great Britain in April 1856, and the Democrats nominated him for President the next month. They chose John C. Breckinridge, former Kentucky congressman, for Vice President. The Republicans nominated two former senators, John C. Frémont of California and William L. Dayton of New Jersey. The Whigs and the Know-Nothing Party both supported former President Millard Fillmore and Andrew J. Donelson, former minister to Prussia.

The Democrats appealed to the desire of conservatives to preserve the Union. The party tried to avoid the slavery question. The Republicans openly fought slavery, and used campaign posters with such slogans as "Free Speech, Free Press, Free Soil, Free Men, Frémont and Victory!" The Know-Nothings attacked both sides. Buchanan fell short of a popular majority, but won a large electoral majority.

Buchanan's election

Place of nominating convention	Cincinnati
Ballot on which nominated	17th
Opponents	John C. Frémont (Republican) and Millard Fillmore (Know-Nothing).
Electoral vote*	Buchanan, 174; Frémont, 114; Fillmore, 8.
Popular vote	Buchanan, 1,836,072; Frémont, 1,342,345; Fillmore, 873,053.
Age at inauguration	65

*For votes by states, see **Electoral College** (table).

Buchanan's Administration (1857-1861)

The struggle over slavery continued with increasing fury throughout Buchanan's Administration. He tried to unite Democrats from the North and the South by balancing his appointments to public office. But many persons felt that he favored the Southerners. At White House social functions, Southerners often outnumbered Northerners. Buchanan's support of the Dred Scott Decision seemed further to hint at Southern favoritism (see **Dred Scott Decision**).

Buchanan's actions on statehood for Kansas convinced still more people that he favored the South. For three years, North and South had argued over whether Kansas should be admitted to the Union as a free or a slave state. Buchanan had endorsed the principle of *popular sovereignty,* which held that the people of a territory should vote whether or not to allow slavery in the territory.

In 1857, proslavery settlers in Kansas drew up the Lecompton constitution, which would have permitted slavery in the new state. It was submitted to Kansas voters for approval. But the antislavery settlers refused to vote, and the proslavery group won the election. Buchanan recommended that Congress accept the Lecompton constitution for Kansas. Senator Stephen A. Douglas, an Illinois Democrat, opposed this procedure. Largely because of his influence, Congress refused to approve the constitution. Congress sent the constitution back to the people of Kansas in 1858, and they defeated it. See **Kansas** ("Bleeding Kansas").

Buchanan's stand on the Kansas question greatly angered the North. In the congressional elections of 1858, Northern candidates opposed to the President won a majority in both houses. The hostile Congress rejected Buchanan's program to enlarge the army and navy, build a Pacific railroad, and develop canals and roads across Panama and Nicaragua. On the other hand, Buchanan vetoed several bills, including one to give free homesteads to settlers on western land.

Foreign affairs. Buchanan developed firm policies in foreign affairs. His experience as a diplomat helped him establish better relations with Great Britain. The problem of British possessions in Central America was solved when Britain signed treaties with Nicaragua and Honduras that Americans approved.

Such disorder existed in Central America that European nations threatened to use troops to protect their citizens there. Buchanan urged Congress to intervene to keep order. Otherwise, he said, Europeans would intervene in defiance of the Monroe Doctrine (see **Monroe Doctrine**). This stand foreshadowed the "Big Stick" pol-

Library of Congress

Harriet Lane, Buchanan's niece, served as hostess for the President. She entertained many important White House guests, including the Prince of Wales, later King Edward VII of Britain.

Vice President and Cabinet

Vice President	* John C. Breckinridge
Secretary of state	* Lewis Cass
	Jeremiah S. Black (1860)
Secretary of the treasury	Howell Cobb
	Philip F. Thomas (1860)
	John A. Dix (1861)
Secretary of war	John B. Floyd
	Joseph Holt (1861)
Attorney general	Jeremiah S. Black
	* Edwin M. Stanton (1860)
Postmaster general	Aaron V. Brown
	Joseph Holt (1859)
	Horatio King (1861)
Secretary of the Navy	Isaac Toucey
Secretary of the interior	Jacob Thompson

*Has a separate biography in WORLD BOOK.

icy of President Theodore Roosevelt. But Congress refused to allow Buchanan to carry out this policy.

Life in the White House. The gloom of the White House during Franklin Pierce's Administration gave way to a brilliant social life when Buchanan took office. Buchanan, who never married, asked his niece and ward, Harriet Lane, to serve as his hostess. Under her guidance, one reception and ball followed another. Buchanan added a conservatory to the White House to provide flowers for these affairs. The most spectacular parties centered around the visit of the Prince of Wales, later King Edward VII of Great Britain. The prince brought such a large party that Buchanan had to sleep in a hallway to provide proper quarters for his guests.

Election of 1860. By 1860, neither Northern nor Southern Democrats considered Buchanan for renomination, nor did he wish it. Southern Democrats nominated Vice President Breckinridge for President, and Senator Joseph Lane of Oregon as his running mate. Northern Democrats chose a ticket of Senator Stephen A. Douglas and former Senator Herschel V. Johnson of Georgia. The Constitutional Union Party named Senator John Bell of Tennessee and former Senator Edward Everett of Massachusetts. Abraham Lincoln of Illinois and Senator Hannibal Hamlin of Maine led the Republican ticket to victory in the election.

Prelude to war. Buchanan faced the gravest responsibility of his career during the period between Lincoln's election and inauguration. South Carolina seceded from the Union on Dec. 20, 1860, and on February 4 met with six other slave states to form the Confederate States of America.

Buchanan declared that there was no "right of secession," as Southerners claimed. But he also pointed out that the Constitution provided no legal way to prevent it. He recommended revising the Constitution in a way agreeable to both North and South as the only alternative to war. He said that the South's refusal to accept defeat at the polls would destroy the tradition of self-government. But he felt it equally destructive to hold Southerners to citizenship by force.

Buchanan based his policy of cautious restraint on two beliefs. First, he felt that by keeping calm, he could retain the loyalty of the eight slave states still in the Union. Second, he believed that if left alone, the seven Confederate states would soon disagree among themselves, and move toward reunion.

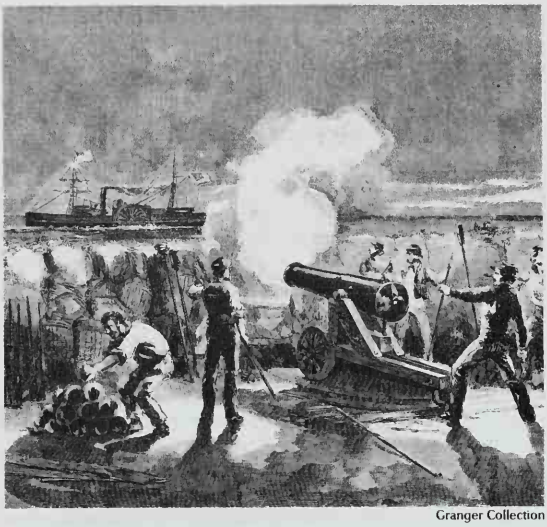
On Dec. 26, 1860, a small garrison of Union troops moved from Fort Moultrie to Fort Sumter, in Charleston Harbor. South Carolina sent commissioners to Buchanan to demand that the garrison be withdrawn. Buchanan refused to surrender the fort. His action caused two Southern Cabinet members to resign because they thought Buchanan was too hard on the South. Secretary of State Lewis Cass had resigned because he thought the policy not hard enough. Buchanan filled the three posts with men who were strongly loyal to the Union.

Buchanan agreed to let the steamer *Star of the West* try to relieve the hard-pressed garrison at Fort Sumter. South Carolinian batteries opened fire on the vessel on Jan. 9, 1861, and forced it to turn back. Buchanan refused to regard the attack on the steamer as an act of war, because no blood had been shed. For one thing, he did not have a large enough army to fight a war. More important, Buchanan wished to hand the government over to Lincoln with an opportunity still available to find a peaceful solution.

During the month after Buchanan left office, he observed with satisfaction that Lincoln continued his policy. When Confederate troops fired on Fort Sumter on April 12, 1861, Buchanan wrote that Lincoln now "had no alternative but to accept the war instigated by South Carolina or the Southern Confederacy." Buchanan publicly urged his fellow Democrats "to support the President with all the men & means at the command of the Country in a vigorous and successful prosecution of the war."

Later years

Buchanan retired to Wheatland after Lincoln's inauguration and followed the events of the Civil War. He spent much time writing a book in defense of his policies, *Mr. Buchanan's Administration on the Eve of the Rebellion.*



Granger Collection

Tensions between the North and South increased when Confederate troops fired on the *Star of the West.* The Union ship was attempting to reach Fort Sumter in Charleston Harbor.

Harriet Lane and a nephew, James Buchanan Henry, lived with him during his last years.

Buchanan died on June 1, 1868. He was buried in Woodward Hill Cemetery in Lancaster, Pennsylvania. Wheatland has been restored and furnished as it was when Buchanan lived there. Philip S. Klein

Related articles in *World Book* include:

Breckinridge, John Cabell
Brown, John
Civil War
Clayton-Bulwer Treaty
Confederate States of America
Douglas, Stephen Arnold
Fort Moultrie
Fort Sumter
Kansas-Nebraska Act
Lincoln, Abraham
Mexican War
Ostend Manifesto
President of the United States
Stanton, Edwin McMasters

Outline

I. **Early life**
II. **Political and public career**
  A. Soldier and legislator
  B. Tragedy
  C. Congressman and diplomat
  D. Senator
  E. Secretary of state
  F. Minister to Great Britain
  G. Election of 1856
III. **Buchanan's Administration (1857-1861)**
  A. The struggle over slavery
  B. Foreign affairs
  C. Life in the White House
  D. Election of 1860
  E. Prelude to war
IV. **Later years**

Questions

What personal tragedy marred Buchanan's early life?
Why did Buchanan advise patience toward the South?
Why did Congress reject Buchanan's legislative program during the last two years of his term?
What did Buchanan achieve as minister to Russia?
Why was Buchanan well qualified for the presidency?
What role did Secretary of State Buchanan play in the territorial expansion of the United States?
Why did Buchanan not take a stand in the debates over the Kansas-Nebraska Bill?
Why did he once sleep in a White House hallway?
When did Buchanan decide civil war in the United States was unavoidable?

Additional resources

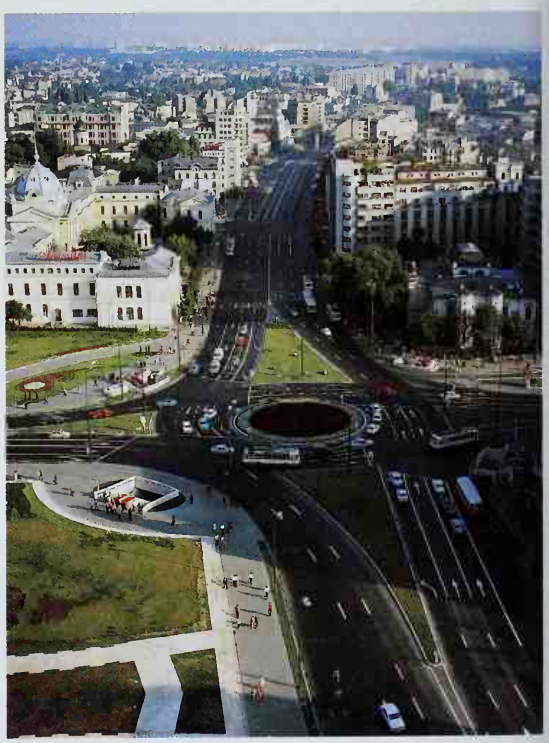
Binder, Frederick M. *James Buchanan and the American Empire.* Susquehanna Univ. Pr., 1994.
Joseph, Paul. *James Buchanan.* Abdo, 2000. Younger readers.

Bucharest, *BOO kuh* REHST or *BYOO kuh REHST* (pop. 2,067,545; met. area pop. 2,350,984), is the capital and largest city of Romania. It is also the nation's chief commercial and cultural center. Its name in Romanian is *Bucureşti.* The city lies in southeastern Romania, on both banks of the Dîmboviţa River. For the location of Bucharest, see **Romania** (map).

In the 1800's and early 1900's, city planners patterned parts of Bucharest somewhat after the design of Paris. For example, Bucharest has many wide boulevards, as does the French capital. Central Bucharest includes many modern hotels, office buildings, and shops, as well as older buildings. The Palace of the Republic, built in 1937, houses the national art museum of Romania. Near the palace stands the Romanian Athenaeum, an attractive concert hall built in the late 1800's. The massive and ornate Palace of Parliament, constructed during the 1980's, is one of the largest buildings in the world.

Other cultural attractions in Bucharest, in addition to the national art museum and the Romanian Athenaeum, include theaters and the Museum of the Village, which has an exhibition of Romanian peasant architecture. Bucharest University is near the center of the city. Bucharest has a number of mansions, some of which are hundreds of years old. The city also has many lakes, parks, and wooded areas.

Many people of Bucharest work in factories or have



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Bucharest, the capital of Romania, has many wide boulevards. The city's central area includes modern and older buildings.

government jobs. Most of the factories are in the suburbs. The area's chief products include chemicals, farm machinery, motor vehicles, and textiles.

According to legend, Bucharest was founded and named after a shepherd named Bucur, who tended his sheep on the site in the 1400's. From the 1400's to the 1800's, Bucharest was ruled by the Ottoman Empire and then Russia. In 1861, Bucharest became the capital of Romania, which had been formed by the union of Moldavia and Walachia. An earthquake struck Bucharest in 1977, causing about 1,500 deaths and $1 billion in damage. The city was quickly rebuilt. During the 1980's, however, Romanian dictator Nicolae Ceauşescu destroyed many churches, houses, and historic buildings as part of a modernization plan. Vojtech Mastny

See also **Romania** (pictures).

Buchenwald, *BOO kuhn VAHLT,* was a concentration camp in Nazi Germany. The Nazis built the camp between 1935 and 1937 near the city of Weimar. People held at Buchenwald included political prisoners and such ethnic prisoners as Jews and Poles. About 57,000 of the prisoners were murdered by the Nazis or died from starvation and disease. Many of those who died were worked to death in Nazi-controlled factories surrounding the camp. The United States Army freed the surviving prisoners in April 1945. Charles W. Sydnor, Jr.

See also **Holocaust** (picture: Holocaust victims).

Büchner, Georg, *BUK nuhr, gay OHRK* (1813-1837), a German writer, is considered a forerunner of the naturalism movement of the late 1800's. His dramas *Danton's Death* (written in 1835) and *Woyzeck* (written in 1836) are distinguished by starkly realistic language. They are filled with disillusionment about Büchner's own time and pessimism about the world in general. According to Büchner, people cannot shape their fate. They are victims of uncontrollable forces and thus entirely helpless.

Büchner also wrote *Leonce and Lena* (written in 1836), a dark comedy dealing with boredom and dread of the unknown. Büchner's short novel *Lenz* is largely a study of a man going insane. It was begun in 1835 and published in 1839, after the author's death from a sudden illness, probably typhus, at the age of 23.

Büchner was born in the German state of Hesse. As a student, he coauthored *The Hessian Courier* (1834), a pamphlet calling for the overthrow of the Hessian government. Büchner fled to the city of Strasbourg to avoid imprisonment. Walther L. Hahn

Buchwald, Art (1925-), is an American newspaper columnist who specializes in political and social satire. He usually puts politicians and other famous people into imaginary settings and invents humorous dialogue for them. His column appears in about 500 papers in many countries. Buchwald won the Pulitzer Prize for commentary in 1982.

Arthur Buchwald was born in Mount Vernon, New York. He dropped out of high school at age 17 and joined the U.S. Marine Corps. He attended the University of Southern California from 1945 to 1948 but did not graduate. He then worked in Paris as a correspondent for *Variety.* In 1949, he became a syndicated columnist for the *International Herald Tribune* in Paris. In 1952, the *New York Herald Tribune* began publishing the column in the United States. The Los Angeles Times Syndicate began distributing the column in 1966. Michael Emery

Buck, Frank (1882-1950), was an American collector of, and authority on, wild animals. He traveled around the world in search of animals for zoos and circuses. Buck's first expedition, in 1911, covered Malaya and Singapore. He later specialized in animals from these areas. Buck collected over 25,000 specimens. He wrote *Bring 'Em Back Alive* (1931) and *Fang and Claw* (1935). Buck was born in Gainesville, Texas. G. J. Kenagy

Buck, Pearl S. (1892-1973), an American author, won the 1938 Nobel Prize for literature. She became best known for her books dealing sympathetically with life in China. Many of her works urged greater understanding between the peoples of Asia and the West.

Buck's best-known novel, *The Good Earth* (1931), won the 1932 Pulitzer Prize. It describes the life of Wang Lung, a Chinese peasant, whose love of the land sustains him through years of hardship. The book is the first in a series of three novels called *The House of Earth,* which also includes *Sons* (1932) and *A House Divided* (1935).

Pearl Sydenstricker was born in Hillsboro, West Virginia. She grew up in China, where her parents were missionaries. She attended college in the United States but later taught in China. In 1917, she married John Buck, a U.S. agricultural expert living in China. They divorced in 1935. That year, she married Richard John Walsh.

Pearl Buck's first book of fiction, *East Wind: West Wind,* was not published until 1930, when she was 38. But from that time until her death, she wrote more than 65 books, plus hundreds of short stories and essays. Her other novels set in the Far East include *Dragon Seed* (1942), *Imperial Woman* (1956), and *The Living Reed* (1963). She also wrote several novels with an American setting under the name John Sedges. Buck wrote two autobiographical works, *My Several Worlds* (1954) and *A Bridge for Passing* (1964). Bert Hitchcock

Additional resources

Doyle, Paul A. *Pearl S. Buck.* Rev. ed. Twayne, 1980.
Harris, Theodore F. *Pearl S. Buck: A Biography.* 2 vols. Day, 1969-1971.

Buck Island Reef National Monument lies under water in a lagoon near the island of St. Croix in the Virgin Islands. It was established in 1961. Its protected waters hold an array of tropical fish and coral formations. Skin divers can follow an underwater trail through this marine garden. For the area of the monument, see **National Park System** (table: National monuments).

Critically reviewed by the National Park Service

Buckeye. See **Horsechestnut.**

Buckingham, Duke of (1592-1628), an English nobleman, was the real ruler of England during the later years of King James I's reign, which ended in 1625, and from 1625 to 1628 under King Charles I. His given and family name was George Villiers. Although a royal favorite, he was extremely unpopular. He failed on several military expeditions, and, after his unsuccessful naval expedition to the Spanish seaport of Cádiz in 1625, he was *impeached* (charged with wrongdoing). Charles I saved him from death, however. On Buckingham's return from a failed military expedition to France, he was assassinated by John Felton, a discontented army officer.

Buckingham was born in the county of Leicestershire, England. The plot of *The Three Musketeers* (1844), a famous historical romance by Alexandre Dumas, centers

about a love affair between Buckingham and Anne of Austria, wife of King Louis XIII of France. Charles Carlton

Buckingham Palace is the London residence of the British monarch. It is located in the West End section of the city. See **London** (map of central London).

Buckingham Palace has four main wings that form a rectangle around a courtyard. It has 600 rooms. The grandest rooms are used for ceremonies and formal social events. The Queen's Gallery exhibits some of the royal collection of fine furniture and works of art. Sentries perform the famous changing-of-the-guard ceremony at the front gates of Buckingham Palace. Behind the palace lies a walled, 40-acre (16-hectare) garden.

It was originally a smaller residence built for the Duke of Buckingham in 1705. In 1762, King George III bought the house. His son King George IV decided by 1819 that the British monarch should have a more impressive home. But arguments between the king and the British government over the design and cost of the building caused many delays. The work was not completed until the 1840's, over 10 years after the king's death.

Robert Harding Picture Library

Buckingham Palace, the London home of the British monarch, stands among formal gardens in the West End district. The huge structure includes the royal living quarters, formal state rooms, and the Queen's Gallery, where public exhibitions are held.

Later monarchs added the east and south wings to the building. In the mid-1820's, the residence was named Buckingham Palace, in honor of its original owner. The palace's east front was refaced in 1913. During World War II (1939-1945), the palace was hit by bombs and needed renovation. Andrew Church

See also **London** (picture: Changing of the guard).

Buckley, William F., Jr. (1925-), an American editor and author, is one of the best-known spokesmen for political conservatism in the United States. He founded the magazine *National Review* in 1955 and served as its editor until 1990, when he resigned. Buckley also writes a widely syndicated newspaper column and conducts a nationally televised discussion program.

William Frank Buckley, Jr., was born on Nov. 24, 1925, in New York City and graduated from Yale University. In his first book, *God and Man at Yale* (1951), he attacked the liberal viewpoints that he said were common at Yale. His other political books include *Up from Liberalism* (1959) and *The Unmaking of a Mayor* (1966). Buckley also has written a number of spy thrillers, starting with *Saving the Queen* (1975). He has told of his own adventures in *Racing Through Paradise: A Pacific Passage* (1987) and other books. In 1965, he ran unsuccessfully as the Conservative Party candidate for mayor of New York City. His brother James L. Buckley served as a U.S. senator of New York from 1971 to 1977. David S. Broder

Buckner, Simon Bolivar (1823-1914), was a lieutenant general in the Confederate Army during the American Civil War. He surrendered unconditionally to Union General Ulysses S. Grant at Fort Donelson in 1862.

Buckner was born on April 1, 1823, in Hart County, Kentucky. He graduated from the United States Military Academy in 1844 and fought in the Mexican War (1846-1848). In 1868, Buckner became editor of the Louisville *Courier.* He was governor of Kentucky from 1887 to 1891. John F. Marszalek

Buckskin is a velvetlike finished leather made from the skin of deer or elk. The leather is finished on the grain side and is usually softened with oil. Buckskin is porous, warm, durable, and washable. It is used for gloves, shoes, and sportswear. Scratches or briar marks sometimes are apparent on the skin. American Indians and pioneers made clothing from the skins of buck deer (see **Leather**). James E. Churchill

Bucktails were a powerful group in the Democratic-Republican Party in the state of New York from about 1816 to 1830. They wanted to keep Tammany, the New York City political machine, in control of state politics. They opposed the reform policies of Governor De Witt Clinton, whose support came largely from rural districts. The Bucktails controlled the Democratic-Republican Party in New York from 1822 to 1824. Their name came from the buck's tail emblem that each member wore in his hat. See also **Democratic-Republican Party; Tammany, Society of.** William W. Freehling

Buckthorn is the name of about 150 species of shrubs and small trees native to the Northern Hemisphere. Most buckthorns grow in mild regions.

The *common buckthorn* is a spiny shrub often grown as a hedge plant. First grown in Europe, this plant was imported to the United States as an ornamental shrub. But in many areas, the common buckthorn became a troublesome weed that crowded out other plants. It may

Hans Reinhard, Bruce Coleman Ltd

The common buckthorn's small fruit grows in clusters.

reach 12 feet (3.7 meters) in height, though it is ordinarily smaller. The leaves are oval and rounded at the base. The flowers, which bloom in May, are small and green, and grow in clusters. The fruits are about $\frac{1}{4}$ inch (6 millimeters) across. There are four seeds in each fruit. The stems are often thorny. The bark yields a yellow dye and is also used as a laxative. Fred T. Davies, Jr.

Scientific classification. Buckthorn belongs to the buckthorn family, Rhamnaceae. The scientific name for the common buckthorn is *Rhamnus cathartica.*

See also Cascara sagrada.

Buckwheat is a plant grown for its starchy seeds. The seeds are milled into flour or meal for use as human food or as feed for livestock. Many people regard buckwheat as a grain, along with such crops as corn, rice, and wheat. But scientists classify buckwheat separately from these crops and do not consider it a true grain.

In the United States and Canada, most buckwheat flour is used in pancakes. Some buckwheat is hulled to produce kernels called *groats,* which are used in soups and breakfast cereals. In Asia, buckwheat flour is mixed with wheat flour to make noodles. In eastern Europe, coarsely crushed buckwheat is cooked to form a mush called *kasha.* Buckwheat is rich in carbohydrates and contains small amounts of protein and fat. It also is a source of iron and of vitamin B complex, especially niacin, thiamine, and riboflavin.

Kitty Kohout, Root Resources

Buckwheat flowers produce seeds used in making flour.

A buckwheat plant grows about 3 feet (91 centimeters) tall. It has an erect central stem and triangular or heart-shaped leaves. The plant bears showy flowers that may be white, pink, red, or greenish. Bees use nectar from the flowers to make a dark, strong-flavored honey. Buckwheat seeds are triangular in shape and gray or black in color. Most seeds measure from $\frac{1}{8}$ to $\frac{1}{4}$ inch (3.2 to 6.4 millimeters) long.

Buckwheat grows best in regions with cool, moist climates. It grows rapidly, maturing 10 to 12 weeks after being seeded. Farmers sometimes plant buckwheat as an emergency crop when a previous crop has failed.

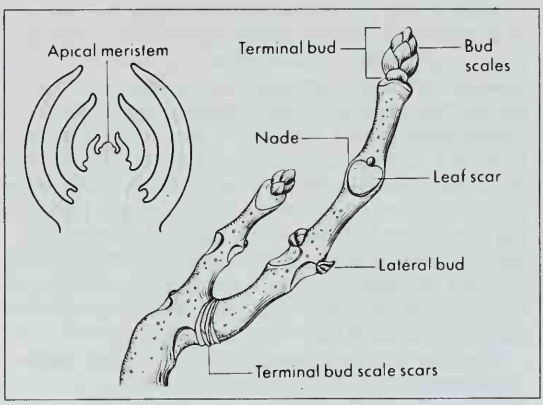
Buckwheat probably originated in Asia. It has been cultivated in China for more than 1,000 years. During the 1800's and early 1900's, buckwheat ranked as one of the major food crops in the United States. Since then, Americans have shown an increasing preference for other grains, and U.S. production of buckwheat has declined dramatically. Donald J. Reid

Scientific classification. Buckwheat belongs to the buckwheat family, Polygonaceae. It makes up the genus *Fagopyrum.* Most of the buckwheat grown in North America is *F. esculentum* or *F. tataricum.*

Bud is a cluster of developing leaves surrounding a growing point of a plant. This growing point is called an *apical meristem.* The apical meristem within each bud contains the cells that divide and grow to form new leaves, flowers, and stems.

Buds of most woody plants are covered by overlapping modified leaves called *bud scales.* Bud scales preserve water and protect the delicate tissues within the bud. During the winter, the buds of many woody plants are *dormant* (inactive). In the spring, the leaves within buds resume their growth, and the expanding leaves on the lengthening shoot sprout from the bud. Later in the season, new leaves gradually form around each meristem's base, forming next year's buds.

On many plants, a *terminal bud* is found at the tip of each shoot. On some plants, *lateral buds* form along the sides of stems. These buds normally develop above the



WORLD BOOK illustration by Sarah Woodward

Buds form on stems. A cross section, *upper left,* shows the *apical meristem* from which new leaves or flowers grow.

Grant Heilman

Horsechestnut bud

John Colwell from Grant Heilman

Apple buds

Shostal

Budapest, the capital and largest city of Hungary, lies on both banks of the Danube River. The domed Parliament Building, *background,* is one of the city's many historic landmarks.

points where a leaf joins a stem. These points are called *nodes,* and the marks left where leaves break away from the stem are called *leaf scars.* Lateral buds that form elsewhere on a stem are *adventitious buds.* Sometimes adventitious buds develop in response to injury.

Most woody plants can be identified by the shape, size, color, and position of their buds. Buds of woody plants may contain leaves or flowers or both leaves and flowers. Leaf buds and flower buds on the same plant can be distinguished by their different shapes and sizes.

Individual flowers, before they bloom, also are called buds. The outer covering of most flower buds consists of leaflike *sepals,* which form the *calyx* (see **Flower** [The parts of a flower]). Some flowers, such as tulips, grow at the tips of shoots. Other flower buds form laterally on stems above regular or modified leaves called *bracts.*

Heads of cabbage and Brussels sprouts are enlarged leafy buds. Broccoli and cauliflower heads consist of many tiny flower buds. Joseph E. Armstrong

See **Plant** (pictures: Stems; How plants grow longer and wider).

Budapest, *BOO duh PEHST* (pop. 1,995,696), is the capital and largest city of Hungary. About 20 per cent of the country's people live in Budapest, the center of Hungarian culture and industry. Budapest lies on both banks of the Danube River in northern Hungary. For location, see **Hungary** (political map).

In 1873, the three adjoining cities of Buda, Pest, and Óbuda united with Margaret Island to form Budapest. Much of the city was destroyed during World War II (1939-1945). The people rebuilt many of Budapest's historic buildings and bridges in their original style.

City. Budapest covers 203 square miles (525 square kilometers). Eight bridges connect the eastern and western banks of the Danube River in Budapest. Margaret Island, in the Danube, is a popular recreation area.

The part of Budapest that used to be the city of Buda lies on the west side of the river. Many historic churches and beautiful old houses cover its steep, wooded hills. The Royal Palace, which includes the remains of an ancient fort, stands on top of Castle Hill in the center of the area. About 75 per cent of the people live on the east side of the river in what was once the city of Pest. This section, built on a series of plateaus, includes various government offices. The Hungarian Academy of Sciences and the House of Parliament are in the old Inner City, called Belváros. Industrial areas border the northern, eastern, and southern parts of the city.

Budapest has a number of museums and other places of interest. The National Museum displays collections from prehistoric, Roman, early Hungarian, and Turkish civilizations. A collection of modern Hungarian art hangs in the National Gallery. City Park features an amusement park, restaurants, and a zoo. Other landmarks include the Hungarian State Opera House, the Millennial Monument, the Museum of Fine Arts, and St. Stephen's Basilica. Budapest is the home of many colleges, universities, libraries, and research centers.

People. Almost all the people of Budapest are Hungarians who speak the *Magyar* (Hungarian) language. A majority of them are Roman Catholics. Other large religious groups include Calvinists and Lutherans.

Many ballets and operas are performed in Budapest. During the summer, crowds attend concerts in the city's parks. Many people also enjoy swimming in Budapest's numerous mineral baths.

Economy. Budapest's labor force once consisted largely of craftworkers and workers in small industries. Since the late 1940's, large industries have become the city's chief employers. Budapest's factories produce nearly half the goods manufactured in Hungary, including chemical products, textiles, and transportation equipment. Other leading products include building materials, electrical equipment, and food products. The city is the banking and finance center of Hungary. Váci Útca, a street in Pest on which vehicular traffic is banned, is a fashionable shopping district.

Budapest lies at the center of Hungary's airline, highway, and railroad systems. The city has several ports on the Danube River, including the free port of Csepel.

History. About A.D. 100, the Romans founded a town called Aquincum on the site of what is now Budapest. Aquincum lay at an easy crossing point of the Danube River. The Huns took control of the settlement in the

early 400's. During the next four centuries, Germanic, Slavic, and various other tribes lived in the area.

Hungarian tribes settled in the valley of the middle Danube during the late 800's. They founded a Christian kingdom there about 1000. This kingdom included settlements that grew into the cities of Buda, Pest, and Óbuda. In the late 1400's, Buda became the home of the royal court. It was also a center of Italian Renaissance art and of the humanistic movement in philosophy (see **Renaissance**). Turkish invaders held Buda from 1541 to 1686. The city then came under the control of the Austrian Habsburgs (or Hapsburgs), a powerful European line of rulers.

In the mid-1800's, Hungarian patriots made Pest a center of culture and politics. Pest became the capital of Hungary in 1848. In 1873, Buda, Pest, Óbuda, and Margaret Island united and formed Budapest. The city's population grew rapidly in the late 1800's and reached 1,110,000 by 1910. During World War II, German and Hungarian Nazis killed much of Budapest's large Jewish population. Hungarian Communists, supported by Soviet troops, took control of the Hungarian government after the war. In 1956, Soviet troops marched into Budapest and put down an anti-Communist revolution.

Since the mid-1900's, Budapest has suffered a severe shortage in housing. In the mid-1960's, the Hungarian government began making low interest loans available for the construction of private housing. Since then, thousands of new housing units have been built. However, the demand for housing continues to exceed its availability.

Thomas Sakmyster

See also **Hungary** (pictures).

Buddha, *BOO duh* (563?-483? B.C.), is the title given to the founder of Buddhism, one of the world's great religions. Buddha's name was Siddhartha Gautama. The title *Buddha* means *Enlightened One.*

Almost no authentic information exists about the details of Buddha's life. But most scholars agree that such a man lived in northern India during the 500's and 400's B.C. Buddha's followers spread the story of his life, and this story has an important place in Buddhism.

Early life. Archaeological excavations completed in 1995 indicate that Siddhartha Gautama was born in Nepal on the Nepal-India border, about 145 miles (233 kilometers) southwest of Katmandu. He spent his youth living in luxury in the palace of his father, the warrior prince Suddhodhana. When Gautama was about 20 years old, he married the princess Yasodhara.

When he was approximately 29, Gautama had a series of four visions. In the first vision, he saw an old man. In the second, he saw a sick man, and in the third, a corpse. In the fourth vision, he met a wandering holy man. The first three visions convinced Gautama that life involves aging, sickness, and death. The vision of the holy man convinced Gautama that he should leave his wife and newborn son, Rahula, and seek religious enlightenment. Such enlightenment would free him from life's suffering.

The search for enlightenment. Gautama became a wandering monk. For six years, he sought enlightenment by practicing extreme forms of self-denial and self-torture. He lived in filth and many days ate only a grain of rice. He also pulled out all the hairs of his beard, one by one. But Gautama finally decided that extreme self-denial and self-torture could never lead to enlightenment. He then abandoned such practices.

One day, Gautama wandered into a village near Gaya and sat under a shady bo tree, also called a bodhi tree. He decided to meditate under the tree until he gained enlightenment. Several hours later, enlightenment came. Others learned of his experience and began to call him Buddha.

Buddha learned from his enlightenment that people could find release from the suffering of life in *nirvana,* a state of complete happiness and peace. To achieve nirvana, people had to free themselves of all desires and worldly things. See **Nirvana**.

Later life. For the rest of his life, Buddha preached the message of how to overcome suffering. This message is called the *dharma,* which means *saving truth.* Buddha preached his first sermon to five holy men in a park near the holy city of Varanasi. The delivery of this sermon is one of the most sacred events in Buddhism.

Buddha preached the dharma throughout northern India and gradually attracted disciples. As the number of his followers grew, Buddha organized them into a religious community of monks, nuns, and laity.

As Buddha's fame increased, stories spread among his followers that dramatically described his magic powers, religious insight, and compassion. His followers believed that Buddha had lived many lives before he was born as Gautama. Many stories describe events of these lives. The stories, called *jatakas,* became popular and helped people understand Buddha's message.

At the age of about 80, Buddha became ill and died. His disciples gave him an elaborate funeral, burned his body, and distributed his bones as sacred relics. Many Buddhists believe his power is still present in these relics and in the many images of Buddha.

Frank E. Reynolds

See also **Buddhism** with its list of *Related articles.*

Buddhism, *BOO dihz uhm,* is one of the major religions of the world. It was founded in India about 500 B.C., or shortly afterward, by a teacher called Buddha. At various times, Buddhism has been a dominant religious, cultural, and social force in most of Asia. In each area, Buddhism has combined with elements of other religions, such as Hinduism and Shinto. Today, Buddhism has about 350 million followers. Most live in Sri Lanka, the mainland nations of Southeast Asia, and Japan.

The beliefs of Buddhism

All Buddhists have faith in (1) Buddha; (2) his teachings, called the *dharma;* and (3) the religious community he founded, called the *sangha.* Buddhists call Buddha, the dharma, and the sangha the *Three Refuges* or *Three Jewels.*

Buddha probably was born sometime during the 500's or 400's B.C. in southwestern Nepal. His real name was Siddhartha Gautama. According to later Buddhist accounts, he was a member of a rich and powerful family. At the age of about 29, Gautama became overwhelmed with the conviction that life was filled with suffering and unhappiness. This conviction led Gautama to abandon his wife and infant son and to seek religious enlightenment as a wandering monk.

After traveling throughout northeastern India for about six years, Gautama experienced enlightenment.

H. Armstrong Roberts

The *Daibutsu Buddha,* a bronze statue, stands in Kamakura, Japan. The statue's restful expression reflects the Buddhist ideal of detachment from all desires and worldly things.

He believed he had discovered why life was filled with suffering and how people could escape from this unhappy existence. After others learned of his discovery, they called him *Buddha,* which means *Enlightened One.* See **Buddha.**

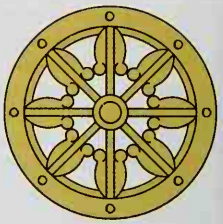
The dharma. Buddha preached that existence was a continuing cycle of death and rebirth. Each person's position and well-being in life was determined by his or her behavior in previous lives. For example, good deeds may lead to rebirth as a wise and wealthy person or as a being in heaven. A person's evil deeds may lead to rebirth as a poor and sickly person or even in hell.

Buddha also taught that as long as individuals remain within the cycle of death and rebirth, they can never be completely free from pain and suffering. Buddha said people could break out of the cycle by eliminating any attachment to worldly things. By ridding themselves of such attachment, people would gain a kind of perfect peace and happiness. Buddha called this state of peace and happiness *nirvana.* According to Buddha, those who are willing and able to follow the Middle Way and the Noble Eightfold Path will conquer their attachment to worldly things and thus achieve nirvana.

The Middle Way is a way of life that avoids both the uncontrolled satisfaction of human desires and the extreme forms of self-denial and self-torture.

The Noble Eightfold Path consists of (1) knowledge of the truth; (2) the intention to resist evil; (3) saying nothing to hurt others; (4) respecting life, morality, and property; (5) holding a job that does not injure others; (6) striving to free one's mind of evil; (7) controlling one's feelings and thoughts; and (8) practicing proper forms of concentration.

After Buddha's death, his followers collected the traditions that had developed around the dharma. The oldest of the many Buddhist schools compiled a scripture called the *Tripitika.* This word means *Three Baskets.* The first part, the *Basket of Discipline,* deals with the rules for regulating the order of Buddhist monks. The second part, the *Basket of Discourses,* consists largely of sermons. The third part, the *Basket of the Higher Dharma,* contains later and more systematic discussions of doctrine. Later Buddhist schools have added their own scriptures.



The wheel, *above,* is an important symbol of Buddhism. It is called both the *wheel of the law* and the *wheel of life.*

The sangha. The word *sangha* sometimes refers to the ideal Buddhist community, which consists of those who have reached the higher stages of spiritual development. The word also refers to the order of Buddhist monks and nuns. In addition, the term means the community of monks, nuns, and laity.

The order of monks has always had a special role within the sangha. It has played an important part in preserving and spreading Buddhism. In many Buddhist groups, the discipline of monastic life is considered essential to those who seriously seek nirvana. In most Buddhist countries, monks are expected to live a life of poverty, meditation, and study. Monks are also expected to avoid sexual activity.

Some Buddhists become monks for life, but others serve in the sangha for only short periods of time. The monks wear special robes and are a common sight in all Buddhist countries.

The laity also has an important role in the life of the sangha. Members are expected to honor Buddha, to follow basic moral rules, and to support the monks. They are also expected to pay special honor to images of

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Buddhist monks chant before a statue of Buddha on an altar decorated with flowers. The monks chant in rhythm to the sound of a metal drum played by the monk standing at the right.

Buddha and to objects that are associated with him.

Many of the laity have influenced the history of Buddhism. During the 200's B.C., Ashoka, an Indian emperor, supported Buddhism. Ashoka established a tradition that has led to close relations between religion and government in many Buddhist countries. In 1956, B. R. Ambedkar, an Indian layman, led a mass conversion that brought more than 1 million former Hindus in India into the sangha.

Buddhist schools

Various Buddhist schools developed in India and in other Asian countries, including the Theravada, the Mahayana, the Mantrayana, and Zen. They have much in common but also differ in important ways.

The Theravada. The word *theravada* means *Way of the Elders.* The Theravada school is the only one of the early Buddhist schools that has survived. Today, it is the dominant religious tradition in Cambodia, Laos, Myanmar, Sri Lanka, and Thailand.

The Theravadans emphasize the importance of Buddha as a historical figure, the virtues of the monastic life, and the authority of the *Tripitaka.* For them, the ideal Buddhist is a kind of saint called an *arhat.* Mahayanists and others have often referred to the Theravada and similar schools as *Hinayana,* a term that means *lesser vehicle.* However, the Theravadans do not accept this name.

The Mahayana. The word *mahayana* means *great vehicle.* Most followers of the Mahayana live in Japan and in the other countries of East Asia. The Mahayanists emphasize the existence of many Buddhas. They often focus attention on Buddhas in heaven and on people who will become Buddhas in the future. The Mahayanists believe that these present and future Buddhas are able to save people through grace and compassion. Most Mahayanists accept many of the Hinayana scriptures, but they believe that their own scriptures reveal a higher level of truth. The Mahayanists teach various ways in which the laity, as well as monks, can achieve nirvana.

The Mahayanists encourage everyone to follow the ideal of the *bodhisattva.* A bodhisattva is a person who vows to become a Buddha by leading a life of virtue and wisdom. At the highest level, a bodhisattva is one who postpones entering into nirvana in order to work to relieve suffering through acts of love and compassion.

The Mantrayana. The word *mantrayana* means *sacred recitation vehicle.* The school's major centers are in the Himalayan regions, in Mongolia, and in Japan. The Japanese call it *Shingon.* Mantrayana Buddhism accepts most Mahayanan doctrines. But it also emphasizes a close relationship between a spiritual leader, sometimes called a *guru,* and a small group of disciples. The disciples spend much time reciting spells called *mantras,* performing sacred dances and gestures, and meditating. Some branches of the school, particularly in Tibet, stress sexual symbolism and believe that sex should be used for holy purposes. Many followers of Mantrayana Buddhism believe in terrifying devils, goblins, and other deities. Attempts to visualize these deities, and the use of magic, play a large part in the school's teachings and rituals. The followers of Mantrayana Buddhism traditionally keep many of their beliefs and practices secret from outsiders.

Zen is practiced chiefly in Japan. It originated in China, where it is called *Chan.* Zen accepts most Mahayanan doctrines and emphasizes a close relationship between a master and his disciples. However, Zen has developed distinctive practices that are designed to lead to a state of spiritual enlightenment called *satori.* Many followers of Zen believe that satori comes in a sudden flash of insight. Others believe that satori must be achieved gradually through a long process of self-discipline, meditation, and instruction. Frank E. Reynolds

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Nirvana
Painting (Asian painting)
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Zen

Additional resources

Bercholz, Samuel, and Kohn, S. C., eds. *Entering the Stream: An Introduction to the Buddha and His Teachings.* Shambhala, 1993.

Ganeri, Anita. *What Do We Know About Buddhism?* Bedrick, 1997. Younger readers.

Reat, Noble R. *Buddhism: A History.* Asian Humanities, 1993.

Snelling, John. *The Buddhist Handbook.* Inner Traditions, 1991.

Budge, Don (1915-2000), an American tennis player, was the first man in history to win the world's four major tennis championships in one year. He won the United States, British, Australian, and French titles in 1938. He helped the United States win the Davis Cup for the first time in 10 years in 1937, and helped defend the cup successfully in 1938. He became a professional player in 1939, and won the world professional title. He retired two years later. Budge wrote two books about tennis, *How Lawn Tennis Is Played* (1937), and *On Tennis* (1939). He became part-owner of a New York City laundry firm in 1941. He was born John Donald Budge in Oakland, California. Arthur Ashe

Budgerigar. See Parakeet.

Budget is a financial plan that helps people make the best possible use of their money. It identifies sources of income and assists in planning expenditures. Income and expenses may vary, and so most budgets consist—at least in part—of estimates.

Individuals, families, businesses, governments, and various organizations all use a budget. A child may have only a few dollars to budget. A government budget may involve billions of dollars. But all budgets resemble one another in certain ways.

Budgets help individuals or groups achieve certain goals. These goals vary, but most people hope to make their income go as far as possible by spending money wisely. Most people, businesses, and governments have limited funds to spend, and so they must decide which expenses are most important. By preparing a budget, they can make sure that enough money is set aside for items that have the highest priority. In addition, a budget may reveal a need for more income. It thus may cause individuals to work longer hours and governments to raise taxes.

Personal and family budgets

A personal or family budget can plan spending on a weekly, monthly, or yearly basis. Some people keep two

separate budgets. One budget covers annual income and expenses. The other covers a shorter period, such as a pay period at a person's place of employment. For example, a person who receives a weekly salary may plan a weekly budget.

Keeping a budget consists of three major steps: (1) estimating income, (2) estimating expenditures, and (3) keeping financial records.

Estimating income is the first step in preparing a budget. The budget should show the amount of money available after all salary deductions have been made. Such deductions include income taxes, social security taxes, and health insurance payments. Estimating income is easy if the total income consists only of a regular salary. However, income from a personally owned business or profession or income that varies with the number of hours worked may change continually. In such a case, the volume of business done or the hours worked during a previous period may serve as the basis of an income estimate.

Estimating expenditures. Certain major expenses remain the same, month after month. They include rent or mortgage payments, insurance premiums, and monthly installment payments. Money for such items should be set aside first. Many other necessary expenses, including clothing, food, recreation, and transportation, vary from month to month and may be controlled to some extent. These expenses can be reduced by buying less expensive items and by watching for sales in stores.

Expenditure patterns vary from person to person, as well as from family to family. Such factors as age, family size, income, and personal tastes all affect individual spending. Some people save to pay for their children's education. Others put money aside to buy a home or an automobile. A family with a low income may have to spend most of its money on food, clothing, and shelter.

In estimating expenditures, individual needs must be analyzed and priorities established. For example, a family may decide to spend less on clothing one year so they can take a vacation.

A personal or family budget may include planned savings. A family may want to save a certain amount to use in an emergency, such as illness or unexpected repairs. The budget should have a surplus that can be used for unexpected expenses.

A budget helps people live within a certain income. People may spend more than they earn in one year by borrowing money or by buying items on credit. But sooner or later they must repay the loans or pay for their purchases. They thus reduce the amount of money available for other items in the budget during the repayment period.

Keeping financial records. Most people who have a budget keep a written record of their plan. They also write down their actual expenditures for various items during the budget period. Such a record of actual spending habits helps plan future budgets. For example, a family may find that they have spent less on recreation than they had planned. The family's next budget could reflect this situation by increasing the amount of money allowed for another item, such as clothing or food.

A basic budget form

Income		
Salary	$	
Salary deductions		
Income taxes	$	
Social security		
Other salary deductions		
Total salary deductions		
Net salary		
Other income (interest, dividends, rent, etc.)		
Total spendable income		$
Fixed expenses		
Home mortgage or rent	$	
Real estate tax		
Homeowner's insurance		
Life insurance		
Health insurance		
Automobile insurance		
Installment payments		
Other fixed expenses		
Total fixed expenses		
Day-to-day expenses		
Food	$	
Clothing		
Other housekeeping expenses		
Utilities		
Home repair and maintenance		
Medical care		
Personal care		
Transportation		
Recreation and entertainment		
Education		
Gifts and contributions		
Other day-to-day expenses		
Total day-to-day expenses		
Savings		
Total budget		$

Business budgets

A budget helps a business company control its costs effectively. It shows the profits expected from various activities of the firm. It also helps management decide which projects are most important for the growth of the firm.

A small company may have one employee who prepares the firm's budget. A large company may have an entire budget department with a full-time staff. This department is directed by a senior executive called a *budget director, controller,* or *treasurer.*

Most businesses depend on sales for their income. This income varies, and so companies must estimate it when preparing a budget. Businesses cannot control all the factors that affect sales, such as the general economic conditions of the country. But firms can influence sales by using advertising, promotion campaigns, and expert salespeople. A business firm can also control its expenses to some extent by better management and by more efficient use of its employees.

Most companies use two types of budget. These types are an overall operating budget and a capital budget.

An overall operating budget summarizes the entire company's financial plans. It is based on the budgets of individual departments. Most companies prepare an annual overall operating budget, but some also have a monthly or quarterly budget. A company's advertising,

production, research, and sales departments may each prepare a budget. The budget department then combines these budgets and makes any necessary adjustments. For example, the sales department of a shoe company may plan to sell 100,000 pairs of shoes in a certain year. The budget of the production department must include the cost of manufacturing that number of shoes. The advertising department's budget must show the cost of informing the public about the shoes and urging people to buy them.

Most companies prepare an income statement at the end of the year that is checked by accountants employed outside the firm. The overall operating budget includes an estimate of income for the next year. Firms compare their year-end income statement with the budget estimate made earlier for the same year. This comparison determines the accuracy of the budget and helps a company plan its future budgets.

A capital budget covers certain kinds of expenditures for a period of several years. It includes the company's expected costs for future construction, equipment, furniture, investments, and land. A capital budget also includes expenditures to replace worn-out buildings and equipment.

In addition, a capital budget shows the proposed sources of funds for the expenditures involved. These sources may include bank loans, company earnings, and the sale of bonds and stock.

Government budgets

Government budgets, like personal and business budgets, involve total *revenue* (income) and total expenditures. Taxes provide most government income. Important areas of spending in the United States government budget include education, health, national defense, social security, and transportation. Government funds are also used to support programs for community development, foreign aid, and space research and technology.

The U.S. budget is prepared annually, but it covers a *fiscal year* rather than a calendar year. The government's fiscal year runs from October 1 to September 30 and is named according to the calendar year in which it ends. The Office of Management and Budget (OMB) prepares the U.S. budget. This federal agency forms part of the Executive Office of the President.

The national budget shows the expected cost of various government activities. It also indicates any increase or decrease in taxes. The budget informs the public about the government's priorities. It also has important effects on the economy of the nation.

Preparation of the U.S. budget. Each of the various departments of the federal government prepares a budget based on general guidelines received from the President. The department heads then defend their proposed expenditures at hearings held by the Office of Management and Budget. The OMB also receives estimates of government tax revenues from the Department of the Treasury. The Office of Management and Budget then prepares the budget under the guidance of the President, who sends it to Congress. The Constitution requires Congress to approve all government expenditures.

The Congressional Budget Office (CBO) analyzes the budget and suggests changes. The budget committees of the Senate and the House of Representatives set general spending goals based on the suggestions of the CBO. Congress then passes *appropriation bills,* which specify how much money each government department may spend. If proposed expenditures exceed the spending target, Congress may have to revise the budget by cutting spending or raising taxes. Or Congress may authorize a budget that has a deficit or a surplus. The revised budget is sent to the President for approval.

The OMB receives funds from the Treasury Department and distributes them to all the government departments. A department may not spend more than the amount approved by Congress unless it requests and receives additional funds. The General Accounting Office (GAO), another federal agency, checks regularly to make sure each government department follows its budget properly.

The budget also shows how the money provided by Congress is spent for specific programs or activities. These programs may be carried out by one or more of the government's departments or agencies. For example, the Department of Agriculture administers the federal Food Stamp Program (see **Food Stamp Program**). Another program, Food for Peace, involves the Department of Agriculture, the Department of State, and other agencies (see **Food for Peace**).

Program budgeting helps government leaders clearly see the cost of individual programs. These leaders can then compare the costs and goals of competing programs. Such comparisons help the government establish its long-range spending priorities.

Economic effects of the national budget can be grouped into three major categories: (1) distribution of resources, (2) control of economic activity, and (3) distribution of income.

Distribution of resources. The government and private businesses use such resources as land, labor, and money to produce goods and services. The goods and services provided by the government make up the *public sector* of the economy. Those produced by private businesses make up the *private sector.* The effect of the national budget is to *allocate* (distribute) resources between the public sector and the private sector. The budget does this by determining what proportion of the nation's resources will serve the public sector. That proportion thus is not available for use by the private sector. The budget also allocates resources within the public sector.

Control of economic activity. Government taxation and spending influence the nation's general level of economic activity. Taxes lessen economic activity by draining personal income and reducing the total spending of the people. Government expenditures pump money into the nation's economy and increase economic activity.

The national budget balances if taxes equal expenditures. If taxes exceed expenditures, the budget has a *surplus,* and the high taxes tend to depress the economy. If expenditures exceed taxes, the budget has a *deficit,* and the high government spending tends to stimulate the economy.

Economists once believed that the national budget should balance every year. But most experts now believe the government should deliberately create a deficit, a surplus, or a balanced budget—whichever is

needed to stabilize the economy. See **Economics** (Government and the U.S. economy).

For much of the late 1900's, however, the United States Congress was unable to eliminate large annual budget deficits that many experts considered harmful to the economy. As a result, Congress passed the Balanced Budget and Emergency Deficit Control Act of 1985. This act, also known as the Gramm-Rudman-Hollings Act, required that the federal budget be balanced by 1991. In 1987, Congress amended the act to defer the target date to 1993. In 1990, Congress abandoned the 1993 target date but continued working to reduce the large annual deficits. In 1998, the federal budget had a surplus for the first time since 1969.

Distribution of income. The national budget can also determine who bears the heaviest burden of taxes and who benefits most from government expenditures. In planning the budget, the government may design its tax system to lessen the gap between high and low income groups. For example, a *progressive income tax,* such as the one that is used in the United States, has a higher tax rate for people in a higher income group. However, a sales tax bears more heavily on people who are on the lowest income levels. These people spend a larger percentage of their income on such taxable items as food and clothing.

Government spending also affects various economic groups differently. For example, people with a low income benefit the most from government spending for public housing and health programs.

State budgets. Most state budgets are prepared by the office of the governor. The state legislature must approve the budget before the plan can go into effect. Taxes are the main source of income for the states. These taxes include sales taxes, state income taxes, and excise taxes on gasoline, tobacco, and liquor. In addition, the states receive federal funds. Major state expenditures include those for education, recreation, transportation, and welfare.

Local budgets. A city may have a budget director who works with the office of the mayor or city manager. Local governments receive money from property, wage, and sales taxes, and they get additional revenue from the state. These funds pay for education, police and fire protection, and the general cost of running the city or county. Paul Taubman

See also **Congressional Budget Office; Management and Budget, Office of; National budget; Taxation.**

Budget, Bureau of the, was a United States government agency that assisted the president in preparing the federal budget. The bureau was established in 1921. In 1970, its functions were transferred to the Office of Management and Budget in the Executive Office of the President. See also **President of the United States** (The Executive Office of the President). Joseph J. Cordes

Budget, Household. See **Budget; Income** (diagram: A U.S. family budget).

Budgie. See **Parakeet.**

Buena Vista, Battle of. See **Mexican War** (Principal battles).

Buenos Aires, *BWAY nohs EYE rays* (pop. 2,965,403; met. area pop. 10,934,727), is the capital and largest city of Argentina. It is also the country's chief port and leading industrial center. About a third of Argentina's people live in the Buenos Aires metropolitan area. The city lies in eastern Argentina, along a broad, muddy, funnel-shaped bay called the Río de la Plata. For location, see **Argentina** (political map).

The name *Buenos Aires* is Spanish for *fair winds.* Early Spanish sailors named the broad harbor at the site for the patron saint of fair winds, Nuestra Señora Santa María del Buen Aire.

The city of Buenos Aires covers an area of 77 square miles (200 square kilometers), and the metropolitan area spreads over 1,421 square miles (3,680 square kilometers). Buenos Aires has few skyscrapers, even in the downtown area. Broad avenues and numerous parks and plazas give the city a sense of spaciousness and tranquillity.

The Plaza de Mayo lies in the heart of Buenos Aires. The *Casa Rosada* (Pink House), which houses the offices of the president of Argentina, is at the east end of the plaza. A wide boulevard called the Avenida de Mayo runs west from the Plaza de Mayo to the Congress Building.

The central business district lies just north and west of the Plaza de Mayo. The Avenida 9 de Julio, the widest street in the world, runs north and south through this district. This street is 425 feet (130 meters) wide. East of the central business district lies the city's waterfront, which has huge docks and other facilities for oceangoing ships.

Residential neighborhoods called *barrios* occupy most of the northwestern, western, and southern parts of Buenos Aires. Each barrio has its own churches, schools, grocery stores, meat markets, and bakeries. One of Buenos Aires' most colorful barrios is La Boca, which is known for its brightly painted houses and excellent Italian restaurants.

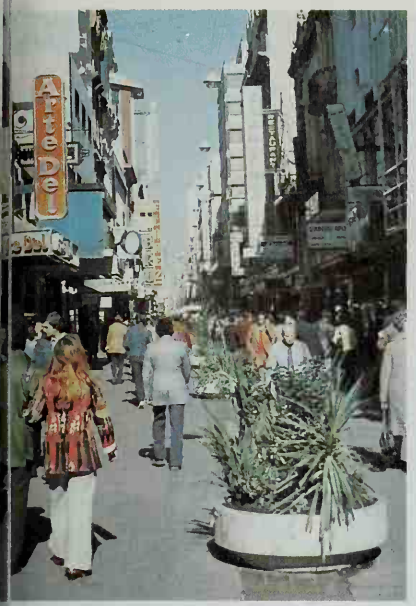
Buenos Aires has many museums and libraries, including the National Museum of Fine Arts, the National Historical Museum, and the National Library. The Colón Theater, in the downtown area, ranks as one of the world's finest opera houses. The city is the home of the University of Buenos Aires.

The people of Buenos Aires are called *porteños* (port dwellers). About three-fourths of them are of Spanish or Italian ancestry. Other groups in Buenos Aires include descendants of English, French, German, Lebanese, Polish, Russian Jewish, and Syrian immigrants. In most of the barrios, the population consists of a mixture of nationality groups.

Almost all the people of Buenos Aires speak Spanish, the official language of Argentina, and many also speak other languages. Buenos Aires has several foreign language newspapers, as well as Spanish ones. Most porteños are Roman Catholics, but many practice other religions.

Many wealthy families of Buenos Aires own mansions in the northern suburbs or have elegant homes near the center of the city. But thousands of poor families live in wooden shacks crowded together in slums in the western and southern suburbs.

Economy of Buenos Aires is based on trade. More than 80 percent of Argentina's foreign trade passes through the capital. Railroads and trucks bring products to the city's port from all parts of the country and carry back other goods. Leading industries in the Buenos



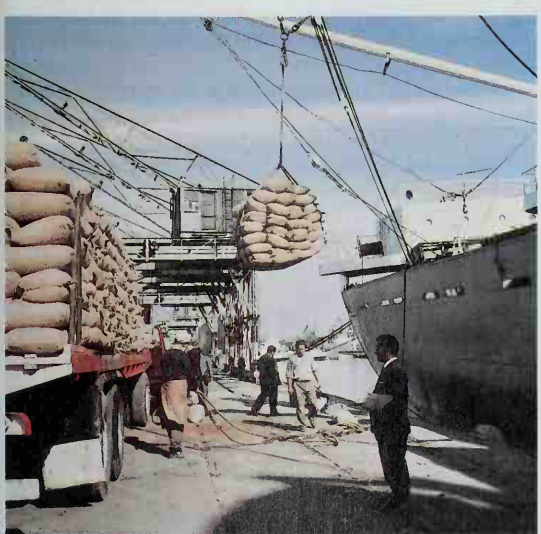
Jacques Jangoux

Shostal

Buenos Aires streets include Calle Florida, *left,* its main shopping area, and Avenida 9 de Julio, *right,* the world's widest boulevard. The boulevard is about 425 feet (130 meters) wide.

Aires area include meat packing; food processing; and the manufacture of textiles, rubber products, and electrical equipment. Many porteños work for the national government.

History. Spanish settlers founded Buenos Aires in 1536, but they left the area five years later because of Indian attacks. A group of settlers from Paraguay, led by a Spanish soldier named Juan de Garay, reestablished Buenos Aires in 1580.



Eric Carle, Shostal

The port of Buenos Aires handles the majority of Argentina's foreign trade. The dockworkers shown above are loading sacks of corn aboard a cargo ship for export.

In 1776, Spain united its colonies in southeastern South America into one large colony ruled by an official called a viceroy. Buenos Aires became the capital and began to flourish as a port. In the early 1800's, local leaders grew dissatisfied with Spanish rule, and the city became the center of the independence movement of South America. Buenos Aires set up its own government in 1810, and other areas ruled by the viceroy declared independence from Spain in 1816. The rulers of some of these areas formed a loose confederation that developed into the nation of Argentina by the mid-1800's. Buenos Aires was officially declared the capital of Argentina in 1880.

In the late 1850's, large numbers of immigrants came to Buenos Aires from Europe and other areas of the world. The city's population rose from about 100,000 in 1850 to almost 1,000,000 in 1900. The period from the 1880's to the 1940's is considered Buenos Aires' "Golden Age." Wide avenues and impressive public buildings were built in the city during those years. Buenos Aires became one of the most beautiful and modern cities in the Western Hemisphere, and the cultural center of Latin America.

Immigration to Buenos Aires from other countries has decreased since the 1930's, but the city's population has continued to grow rapidly. Every year, thousands of Argentines move to the city from rural areas in search of jobs. The population of the metropolitan area had increased from about $4\frac{1}{2}$ million in the 1940's to about 11 million in the early 1990's. The city's industries have been unable to employ all the newcomers, and widespread poverty has resulted. The city's housing and transportation problems have also increased.

Richard W. Wilkie

See also **Argentina** (Colonial days; pictures); **Río de la Plata.**

Richard Erdoes, Alpha

The American buffalo cares for its young until the calf is about 3 years old. The animal reaches adulthood at the age of 8. Millions of buffaloes, the largest American animal, once roamed the United States and Canada. Today, nearly all of them live in game preserves.

Leonard Lee Rue, NAS

The Cape buffalo of southern Africa is extremely dangerous when attacked or surprised. It can kill lions with its heavy hoofs and horns, and has also killed many hunters.

Buffalo is the common name of several kinds of large wild oxen. The name was first given to the black *water buffalo* of India. This large animal was so named because it likes to soak itself in pools of water for hours at a time. In its wild state, the water buffalo can be dangerous. Wild water buffaloes have become scarce because people have hunted them and cleared their forest habitats for farmland. *Domestic* (tame) water buffaloes are used as beasts of burden in most of the warmer parts of Asia and Africa. The *carabao* is a small Philippine variety of domestic water buffalo. See **Water buffalo**.

A wild black buffalo, called the *tamarau,* lives in dense forests on the Philippine island of Mindoro. This small buffalo stands only 3 $\frac{1}{2}$ feet (107 centimeters) high. The *anoa,* a still smaller forest buffalo, lives on the Indonesian island of Sulawesi. These animals are quite rare and are classified as endangered species.

Wild buffaloes also live in Africa. The *Cape buffalo* of South Africa is a large, black animal with nearly as bad a temper as that of the Indian buffalo. It resembles the Indian buffalo in many of its habits, but has never been tamed. Another wild buffalo, related to the Cape buffalo, lives in forested regions in western and central Africa. One form of this buffalo lives in the Congo region. Like the tamarau, it stands only 3 $\frac{1}{2}$ feet (107 centimeters) high.

American buffalo, or bison. Most Americans know this large wild animal simply as "buffalo." But zoologists do not consider it a true buffalo. They call it a *bison.* Unlike the buffaloes already described, it has a large head

and neck and humped shoulders. It also has 14 pair of ribs, instead of the 13 pair found in true buffaloes.

The American bison, or "buffalo," is brownish-black, except on the hind part of the body, which is brown. Long, coarse hair covers the head, neck, and hump. The hair forms a beard on the throat and chin. The head has a pair of horns like those of domestic cattle. Some pairs of horns spread 35 inches (89 centimeters) at their widest point. A full-grown *bull* (male) measures from 10 to 12 $\frac{1}{2}$ feet (3 to 3.8 meters) long, from the tip of his nose to the end of his short, tufted tail. His height at the shoulders measures from 5 $\frac{1}{2}$ to 6 feet (1.7 to 1.8 meters). Bulls usually weigh from 1,600 to 2,000 pounds (726 to 910 kilograms). Extremely large ones may weigh as much as 3,000 pounds (1,400 kilograms). *Cows* (females) are much smaller than bulls and rarely weigh more than 900 pounds (410 kilograms).

Great herds of bison once roamed over North America between the Appalachian Mountains on the east and the Rockies on the west. Indians depended upon bison flesh for food and bison hides for clothing. In 1850, about 20 million bison still thundered over the western plains. Huge herds often forced railroad trains to stop while the animals crossed the tracks. In the late 1800's, white American hunters slaughtered millions of bison. This killing deprived the Indians of their main source of food and almost wiped out the bison.

Protection of bison. By 1889, fewer than 1,000 bison could be found alive in the United States. Then efforts started to prevent the whole species from becoming extinct. William Temple Hornaday, an American zoologist, did much to protect and increase the herds. Game laws and other protective measures allowed the surviving American bison to live and multiply. As a result, about 10,000 bison now live in national, state, and local preserves in the United States. About 3,000 bison roam on public lands in Canada. Most of these animals live in the immense Wood Buffalo National Park, south of Great Slave Lake, and in the Elk Island National Park, near Edmonton. In addition, there are more than 300,000 bison on private ranches throughout the United States and Canada.

Bison are social animals and live in herds. The bulls and the cows graze together throughout the year. A single yellowish-red calf is born in May or June. The bull that leads the herd helps mother cows defend their calves from enemies.

Bison mate when they are 3 years old, but they do not become full-grown for another five years. In rare cases, they may live to be 30 or even 40 years old. Their quick tempers have made it impossible to train the animals in captivity.

Bison feed mostly on grass. They also eat a few other small plants, as well as twigs of willows and low shrubs. Some animal breeders have crossed American bison with ordinary domestic cattle. The resulting *beefaloes* and *cattaloes* feed on grass and do not require the costly grain feeding needed to fatten cattle.

A cousin of the American bison, called the *wisent,* was once numerous in Europe. But by the early 1900's, few of these animals remained. Programs involving the breeding of captive wisents saved the animal from extinction. About 2,000 animals roam in forests in Belarus, Lithuania, Poland, Russia, and Ukraine. The wisent's head is smaller and carried higher than that of the American bison. Thomas L. Poulson

Scientific classification. Buffaloes and bison belong to the bovid family, Bovidae. They are in the subfamily Bovinae. The scientific classification for the water buffalo in India is *Bubalus bubalis.* The Cape buffalo of Africa is *Syncerus caffer,* and the Congo species is *S. nanus.* The American bison is *Bison bison.* The European bison is *Bison bonasus.*

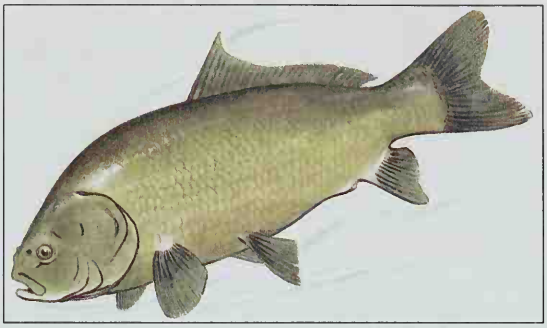
See also **Belarus** (picture: European bison); **Buffalo ceremonials; Conservation** (picture: The slaughter of buffaloes); **Indian, American** (Indians of the Plains; pictures); **Water buffalo.**

Additional resources

Danz, Harold P. *Of Bison and Man.* Univ. Pr. of Colo., 1997.
Fitzgerald, David. *Bison: Monarch of the Plains.* Graphic Arts Ctr., 1998.
Geist, Valerius. *Buffalo Nation: History and Legend of the North American Bison.* Voyageur Pr., 1996.
Potts, Steve. *The American Bison.* Capstone, 1997. Younger readers.

Detail of an India ink and pencil sketch from *Travels in the Interior of North America 1832-1834* by Prince Maximilian of Wied; the Schweitzer Gallery, New York City

Indians hunted buffalo for food and for the hides, which they made into clothing. This eyewitness sketch was made by Karl Bodmer, a Swiss artist who toured North America in the early 1830's.



WORLD BOOK illustration by John F. Eggert

The bigmouth buffalo is a large food fish.

Buffalo is the name of three species of large, dark-colored fish that live in fresh water. They inhabit rivers and shallow lakes from southern Canada to Guatemala. Buffalo are valuable food fish. The *bigmouth buffalo* may grow to 3 feet (91 centimeters) long and weigh up to 50 pounds (23 kilograms).

Buffalo resemble carp, but they lack *barbels* (whiskers) around the mouth. They have a slightly humped back. Buffalo feed primarily on *zooplankton,* a mass of tiny organisms that floats in the water.

Robert D. Hoyt

Scientific classification. Buffalo belong to the sucker family, Catostomidae. The bigmouth buffalo is *Ictiobus cyprinellus.*

See also **Fish** (picture: Fish of temperate fresh waters).

Buffalo, New York, is the second largest city in the state and a center of transportation and industry. Among the cities of New York, only New York City has more people.

Buffalo lies at the head of the Niagara River at the eastern end of Lake Erie. For location, see **New York** (political map). The Canadian town of Fort Erie, Ontario, lies across the Niagara River from Buffalo. Niagara Falls, the most famous waterfall in the United States, is about 20 miles (32 kilometers) north of Buffalo.

In 1803, the Holland Land Company established a settlement at the site of what is now Buffalo. The firm, formed by a group of Dutch businessmen, chose the site because it lay at the western end of an important Indian trail. This trail ran from western New York to the upper Great Lakes and Canada. The community was first named New Amsterdam. But the settlers insisted on calling it Buffalo, which became the official name in 1816. The settlers may have taken the name from Buffalo Creek, a nearby stream.

Two United States presidents—Millard Fillmore and Grover Cleveland—were citizens of Buffalo. Fillmore lived in the city as a young man. He returned to Buffalo after his presidency and died there in 1874. Cleveland served as mayor of Buffalo in 1881.

The city covers 50 square miles (129 square kilometers), including 8 square miles (21 square kilometers) of inland water. It is the seat of Erie County. The Buffalo-Niagara Falls metropolitan area consists of Erie and Niagara counties.

The 40-story Marine Midland Center is the tallest building in Buffalo. It rises above the downtown area near the lakefront. City Hall and several other public buildings stand on or near Niagara Square in downtown Buffalo. The square also includes a stone obelisk dedicated to President William McKinley, who was assassinated in the city in 1901.

The Prudential Building (originally called the Guaranty Building), near Niagara Square, is one of the most famous buildings designed by the noted American architect Louis Sullivan. The Buffalo area features a number of other examples of significant architecture, including several residences designed by the well-known American architect Frank Lloyd Wright. In addition, American

© James Blank, West Stock

Buffalo is the second largest city in New York. It is an important Great Lakes port. The city stands along the eastern shore of Lake Erie at the head of the Niagara River. The large buildings in the foreground are county government buildings.

landscape architect Frederick Law Olmsted designed the city's park system.

The town of Amherst is Buffalo's largest suburb. Amherst has a population of about 115,000. Other large suburbs of Buffalo include Cheektowaga, Lackawanna, Lancaster, North Tonawanda, Tonawanda, and West Seneca.

People. African Americans make up the largest ethnic group in the city. They form more than a third of Buffalo's population. Other large groups in the city include those of English, German, Irish, Italian, Polish, or Russian descent.

Economy. Buffalo's location contributes much to the economic importance of the city. For example, Niagara Falls, which provides a large supply of low-cost hydroelectric power, has attracted many industries to Buffalo. Lake Erie has helped the city become an important inland seaport. Hundreds of Canadian companies have established U.S. bases in Buffalo since the two countries enacted a free trade agreement in 1989.

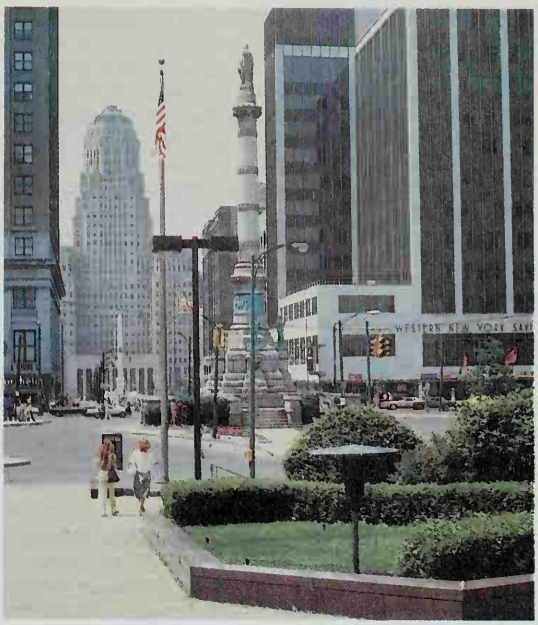
Buffalo began to shift from dependence on heavy industry, such as machinery production and steelmaking, to a more balanced economy in the 1980's. Light industry—including food processing and the manufacture of computers, electronics, and other high-technology products—grew in importance. Service industries, which provide services instead of manufactured goods, also increased. Manufacturing plants employ about a fifth of the Buffalo area's workers. Service industries provide about a fourth of the area's jobs.

Leading industries in the area produce chemicals, fabricated metal products, food and food products, machinery, paper and paper products, printed materials, and transportation equipment. Electronics and computer-related industries have expanded rapidly in the area. Buffalo is an important producer of flour, and its grain elevators make the city a major grain-handling facility.

The Port of Buffalo is the first major U.S. port reached by ships traveling from the Atlantic Ocean to Great Lakes ports. Buffalo lies at the western end of the New York State Barge Canal System and is the largest inland port in New York. Buffalo once served as one of the world's largest inland ports. But fewer ships needed to pass through the city once the St. Lawrence Seaway opened in 1959. The decline of Buffalo industries in the 1970's also added to the port's decreased activity.

Buffalo ranks as one of the nation's largest railroad centers. Major U.S. railroads provide freight service to the city, and passenger trains link it to other U.S. cities. A Canadian railroad also serves Buffalo. Airlines use the Greater Buffalo International Airport. About a sixth of all U.S.-Canadian trade passes through Buffalo.

Major highways that serve Buffalo include the 559-mile-long (900-kilometer-long) Governor Thomas E. Dewey Thruway, the world's longest toll superhighway. The Peace Bridge, 4,400 feet (1,340 meters) long, spans the Niagara River and links Buffalo with Fort Erie, Ontario. Buffalo has one daily newspaper, *The Buffalo News*.



© R. Sullivan, After Image

Lafayette Square, *foreground,* lies in the heart of downtown Buffalo. The 32-story Buffalo City Hall rises in the background.

Education. Buffalo's public school system includes about 60 elementary schools and 14 high schools. The city has more than 70 private elementary schools and high schools. More than 50 percent of the public school students are nonwhites, primarily African Americans. Through a system of *magnet* schools, Buffalo offers special educational programs that attract students of various races from throughout the city.

The State University of New York at Buffalo has campuses at the northern edge of the city and in neighboring Amherst. It is the largest school in the state university system. The Buffalo area is the home of the State University of New York College at Buffalo and four private colleges—Canisius, Daemen, D'Youville, and Medaille. It also has community colleges.

The Buffalo and Erie County Public Library operates a main library in downtown Buffalo. It also operates branches throughout the city and suburbs.

Cultural life and recreation. The Buffalo and Erie County Historical Museum features a reproduction of a Buffalo street of 1870. The museum building served as the New York State Building at the Pan American Exposition of 1901. The Buffalo Museum of Science, established in 1861, has many exhibits on the geology and plant life of western New York. The Albright-Knox Art Gallery features an outstanding collection of modern art, including sculptures and French paintings.

Facts in brief

Population: *City*—292,648. *Metropolitan area*—1,170,111.
Area: *City*—50 mi² (129 km²). *Metropolitan area*—1,568 mi² (4,061 km²).
Altitude: 599 ft (183 m) above sea level.
Climate: *Average temperature*—January, 35 °F (2 °C); July, 70 °F (21 °C). *Average annual precipitation* (rainfall, melted snow, and other forms of moisture)—36 inches (91 centimeters). For the monthly weather in Buffalo, see New York (Climate).
Government: Mayor-council. *Terms*—4 years for the mayor, council president, and three at-large council members; and 2 years for nine council members.
Founded: 1803. Incorporated as a city in 1832.

Kleinhans Music Hall is the home of the Buffalo Philharmonic Orchestra. The hall also presents music recitals. It has two auditoriums, one seating 2,900 people and the other about 800. A professional theater company performs at the Studio Arena Theatre. Shea's Buffalo Theater, which seats 3,000, presents plays and musical performances by touring groups.

Buffalo's park system, designed by Frederick Law Olmsted, includes about 75 parks and playgrounds and covers about 1,500 acres (607 hectares). It is possible to drive almost completely around the city through parks and parkways. Delaware Park, which covers 365 acres (148 hectares), is the largest park in Buffalo. It includes the Buffalo Zoo and a 46-acre (19-hectare) lake. Boaters also enjoy the city's lakefront. Many of the hills near Buffalo attract skiers. Rotary Rink offers ice skating in downtown Buffalo .

The city is the home of the Buffalo Sabres of the National Hockey League. The Buffalo Bills of the National Football League play their home games at a stadium in nearby Orchard Park.

Other interesting places to visit in Buffalo include:

Allentown, an area of restored early American houses in downtown Buffalo. It is the site of an annual outdoor art festival.

Botanical Gardens, in South Buffalo, a large display of exotic plants housed in 12 greenhouses.

Darwin D. Martin House, on Jewett Parkway, an example of the "prairie architecture" of the well-known American architect Frank Lloyd Wright. Wright designed the nearby Barton House in the same style.

Red Jacket Monument, which honors Chief Red Jacket, a famous Seneca Indian who lived in the Buffalo area. The monument marks Red Jacket's grave in Forest Lawn Cemetery.

Site of McKinley assassination, in Fordham Drive near Lincoln Parkway. A bronze tablet set in a rock marks the spot where, in 1901, President William McKinley was shot while holding a public reception in the Temple of Music at the Pan American Exposition.

Wilcox Mansion, in Allentown, a house in which Vice President Theodore Roosevelt took the oath of office as president in 1901. The ceremony followed the assassination of President McKinley at the Pan American Exposition. The house is now a national historic site.

Government. Buffalo has a mayor-council form of government. Voters throughout the city elect the mayor, the president of the Common Council, and three at-large council members. All are elected to four-year terms. Voters in districts also elect nine council members to two-year terms.

The mayor administers the city government and appoints the heads of various city departments. These appointments are subject to the approval of the Common Council. The council also passes the city's laws and adopts the city budget. Property and sales taxes provide most of Buffalo's revenue.

Like most other large cities, Buffalo has a difficult time paying the soaring costs of city government. The city has lost much tax revenue because many people and industries have moved from Buffalo to its suburbs. The state government shares its tax revenue with Buffalo to help the city meet its expenses.

History. Iroquois Indians lived near the site of what is now Buffalo before Europeans arrived. The first white settler in the area was the French trader Daniel de Joncaire, Sieur de Chabert et Clausonne, who came in the 1750's. The settlement that became Buffalo was established in 1803. By 1810, about 1,500 people lived there.

The town became the headquarters for U.S. military operations during the War of 1812. An invading force of British and Indians burned the town in 1813. However, the town was quickly rebuilt. Buffalo was incorporated as a village in 1816 and became the county seat of Erie County in 1821.

Buffalo grew rapidly after the Erie Canal opened in 1825. The canal provided an important link in an all-water route between New York City and Buffalo and lowered the cost of transporting goods. Buffalo became a major transfer point for people moving from the East to the West. By 1832, when Buffalo was incorporated as a city, it had a population of about 10,000.

In 1840, the world's first grain elevator was built in Buffalo. In 1843, the city became the site of the world's first steam-operated grain elevator. This elevator helped make Buffalo the leading grain-handling port of the United States.

During the mid-1800's, thousands of European immigrants settled in the city. By 1860, Buffalo had a population of 81,129. Rapid industrial growth occurred in the city after 1896, when large-scale production of electric power began at Niagara Falls. This power supply helped Buffalo attract chemical companies, steel plants, and many other industries that used large amounts of electric power. The population of Buffalo soared to 352,387 by 1900.

Buffalo became a center of world interest in 1901, when the Pan American Exposition was held there. This huge fair promoted unity and understanding among the nations of North and South America. On September 6, President William McKinley was shot as he held a public reception in the exposition's Temple of Music. He died in Buffalo eight days later, and there Vice President Theodore Roosevelt took the oath of office as president.

Buffalo's industries provided great amounts of weapons, supplies, and food to the Allies during World War I (1914-1918) and World War II (1939-1945). By 1950, the city's population reached a record high of 580,132. After 1950, the city's population declined. By 1980, it had fallen to 357,870. Several factors contributed to this decline. Many people moved from cities to live in the suburbs. The completion of the St. Lawrence Seaway in 1959 reduced the city's importance as a rail and canal link to the Great Lakes. Through the late 1900's, a number of factories in Buffalo closed, and many people left the city to look for jobs elsewhere.

Hoping to reverse the city's population decline, Buffalo officials developed large urban renewal programs and encouraged businesses to modernize the downtown business district. In response, the Main Place shopping-office complex and several bank towers were built in the city during the late 1960's and early 1970's.

A major building program, the Waterfront Redevelopment project, began in the 1970's. Completion of the Marine Midland Center in 1973 ended the first part of the project. By 1980, several office buildings and a 500-room hotel had also been completed. Construction of Waterfront Village, another phase of the Waterfront Redevelopment project, took place in the late 1900's. Waterfront Village features a marina, a restaurant, office buildings, and town houses.

Other redevelopment efforts included the construction of two hotels and several office buildings in the ear-

ly 1980's. In 1986, a light rail rapid transit system began operations, and a downtown mall was built. An office complex, numerous office buildings, and a hotel were also completed in downtown Buffalo in 1990.

Through the 1990's, the city's population continued to decline. By 2000, it had fallen to 292,648.

In the beginning of the 2000's, the city and its surrounding area looked to tourism to improve the economy. The city focused on promoting its architectural and cultural heritage to draw visitors in combination with nearby Niagara Falls. Future plans included the re-creation on the city's waterfront of the Erie Canal station, which served as the western end of what was the first important national waterway built in the United States.

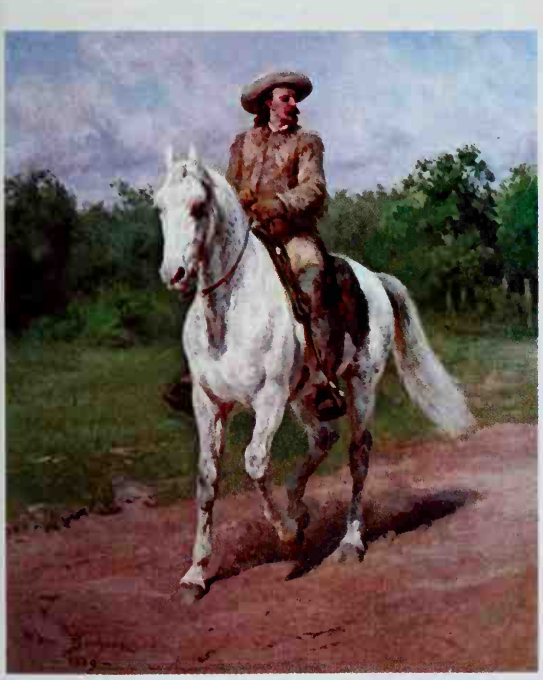
Margaret M. Sullivan

See also **Cleveland, Grover** (Political career); **Erie Canal; New York State Barge Canal System.**

Buffalo Bill (1846-1917), whose real name was William Frederick Cody, was a frontiersman and noted marksman of the American West. Cody later became a popular showman.

Cody was born on Feb. 26, 1846, in Le Claire, Iowa. When he was 8, his family moved to Kansas. After his father died in 1857, he rode a mule as a messenger for a freighting firm. He went to school for a year, then made trips west with wagon trains. He looked after livestock at first, then drove a team of horses. In 1860, Cody rode on a mail route for the pony express.

During the American Civil War (1861-1865), Cody joined pro-Union Kansas militias that were not part of the regular army, and the Ninth Kansas Volunteers. He later served as a *teamster* (driver of horse teams) in the Seventh Kansas Volunteer Cavalry. After the Civil War, Cody operated a hotel in a Kansas village. When the hotel venture failed, Cody started a freighting business, but then Indians captured his wagons and horses.



Whitney Museum of Western Art, Cody, Wyoming

"Buffalo Bill" Cody was painted on horseback by Rosa Bonheur, the famous French artist. Before becoming a circus showman, he is said to have killed over 4,000 buffaloes in 18 months for workers building a western railroad. This earned him his nickname.

After speculating in land and doing railroad construction work, he became a buffalo hunter, supplying meat for workmen building a railroad west across Kansas. His skill with a rifle earned him his nickname, "Buffalo Bill."

From 1868 to 1872, Cody served as a civilian scout for military forces fighting Indians in the West. Between campaigns, he served as a guide for several parties of buffalo hunters. Cody was awarded the Medal of Honor for his role in a fight with Indians on the Platte River in 1872. The medal was revoked in 1917 because Cody was not a member of the military at the time the award was made. The Department of the Army reinstated Cody's medal in 1989.

Late in 1872, Cody began his long career as a showman. He appeared first in "Wild West" shows in theaters. He took the leading role in a play, *Scouts of the Prairies,* which co-starred "Texas Jack" Omohundro and, later, Wild Bill Hickok. But Cody made several trips back to the plains to scout and to raise cattle. In 1876, he took part in a skirmish with Cheyenne Indians in which he killed and scalped a young chief, Yellow Hand.

Early in 1883, Cody and others formed "Buffalo Bill's Wild West," a traveling show that toured the United States and parts of Europe. The show included a mock battle with Indians and a demonstration of Cody's shooting skill. Cody performed until shortly before his death.

After 1894, Cody lived on a ranch in the Bighorn Basin in northwestern Wyoming. He died on Jan. 10, 1917. His grave is on Lookout Mountain, near Denver, Colorado.

William W. Savage, Jr.

See also **Nebraska** (Places to visit; picture: Buffalo Bill's home); **Oakley, Annie.**

Additional resources

Kasson, Joy S. *Buffalo Bill's Wild West.* Hill & Wang, 2000.
Rosa, Joseph G., and May, Robin. *Buffalo Bill and His Wild West.* Univ. Pr. of Kans., 1989.
Sanford, William R., and Green, C. R. *Buffalo Bill Cody.* Enslow, 1996. Younger readers.
Sorg, Eric V. *Buffalo Bill: Myth & Reality.* Ancient City, 1998.

Buffalo ceremonials were rites honoring the animals that provided food, shelter, and clothing to many Indian tribes. At the sun dance of the Plains tribes, when warriors tortured themselves imploring the sun for power, they placed a buffalo skull on top of the central pole. A successful dance meant not only visions for the warriors but also good hunting for the tribe. Important Plains Indian military societies were named after the buffalo bull and used its horns as insignia. The sacred "calf pipe" of the Oglala band of the Teton Sioux, a symbol of good fortune for the group, was said to have been given them by a female buffalo who took human form. Southwestern tribes, which only took short trips into the Plains, held winter ceremonies to bring luck to the summer hunt.

At Taos, New Mexico, a crowd of men wearing buffalo heads swayed and pawed the earth like bison. In other pueblos, two or more men in buffalo masks danced beside a woman, the "mother of game," who supposedly brought the animals to the hunters.

W. Roger Buffalohead

Buffalo fish. See Buffalo.

Buffalo Soldiers was a name given to the 9th and 10th cavalry regiments of the United States Army, which were made up of African American soldiers. Members of all-black infantry regiments that served in the West, primarily the 24th and 25th infantry regiments, are also sometimes called Buffalo Soldiers. Although the enlisted soldiers in these cavalry and infantry regiments were African Americans, nearly all their commissioned officers (officers above the rank of sergeant) were white. Formed in 1866, the 9th and 10th cavalries were sent to the West in 1867 to fight Indians. The Indians gave the troops the name Buffalo Soldiers, probably because they thought their short, dark, curly hair resembled the mane of the buffalo. The buffalo was the most important animal to the Indians, and the name Buffalo Soldiers was a sign of respect.

The Buffalo Soldiers performed many duties in addition to fighting Indians. They were assigned to capture outlaws and to protect pioneers. The Buffalo Soldiers patrolled the Rio Grande border between the United States and Mexico and scouted land in the West. Between about 1870 and the mid-1890's, Buffalo Soldiers won 13 Medals of Honor.

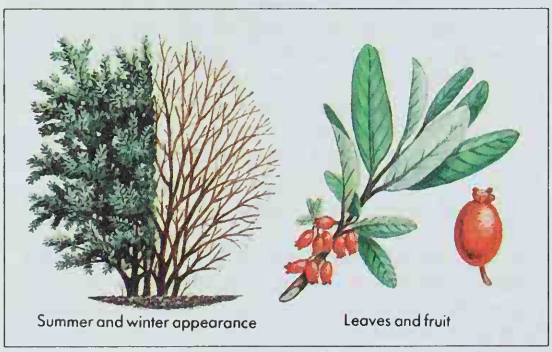
During the Spanish-American War of 1898, Buffalo Soldiers rescued some of Theodore Roosevelt's Rough Riders at the Battle of Las Guasimas in Cuba. The Buffalo Soldiers fought with the Rough Riders in the charge up Kettle Hill in the Battle of San Juan Hill. Buffalo Soldiers fought overseas in World War II, from 1942 to 1944. During the Korean War (1950-1953), the practice of segregating army units racially was ended. Nudie Eugene Williams

Buffaloberry is the name of two species of shrubs or small trees found in parts of the United States and in Canada. The two species are the *silver buffaloberry* and the *Canadian buffaloberry.*

The silver buffaloberry grows from Manitoba to Alberta southward to New Mexico and Arizona. It is most often found on riverbanks and in canyons. It grows to a height of 20 feet (6 meters). The silver buffaloberry produces pea-sized fruit that is usually bright red. The fruit is sometimes made into jelly.

The Canadian buffaloberry is most commonly found in northern Canada. It also grows in parts of the northeastern and north-central United States and may be found as far south as New Mexico. It measures from 3 to 9 feet (0.9 to 2.7 meters) tall. The Canadian buffaloberry produces inedible fruit that is usually yellowish-red. Both species of buffaloberries are widely planted in yards and parks. Norman L. Christensen, Jr.

Scientific classification. Buffaloberries belong to the oleaster family, Elaeagnaceae. The silver buffaloberry is *Shepherdia argentea.* The Canadian buffaloberry is *S. canadensis.*



WORLD BOOK illustration by John F. Eggert

The silver buffaloberry produces bright red fruit.

Buffett, Warren Edward (1930-), an American business executive, is chairman of the board of directors of Berkshire Hathaway Inc., a major United States holding company. Berkshire Hathaway's holdings consist of insurance companies and manufacturing, retail, and publishing businesses—including the publisher of *The World Book Encyclopedia.* Buffett is known for buying into undervalued firms.

Buffett was born on Aug. 30, 1930, in Omaha, Nebraska. He received a bachelor's degree from the University of Nebraska in 1950 and a master's degree in business administration from Columbia University in 1951.

After graduation, Buffett worked first as an investment salesman with his father's brokerage firm in Omaha, then as a security analyst in New York City. In 1956, Buffett borrowed money from relatives and friends and formed an investment firm, the Buffett Partnership. By the time he dissolved the firm in 1969, the investors had received 30 times their original investment. Buffett then turned his attention to building up Berkshire Hathaway, a Massachusetts textile firm he had bought control of in 1965. The textile business eventually failed, and Buffett closed it in 1985. But by that time, he had developed Berkshire Hathaway into a profitable holding company. John C. Schmeltzer

Buffing. See Grinding and polishing.

Bug is the common name of all insects, but true bugs are insects of the order Hemiptera. There are many different kinds of Hemiptera. Some are very large, and some are almost too small to be seen. Some have wings, and others do not. Bugs may live in water, but most bugs live on land. No Hemiptera has teeth or chewing parts. They suck blood or juice from animals or plants through horny, jointed beaks attached to their heads.

Some bugs give off an unpleasant odor for protection. They are called *stink bugs.* Some bugs have "bug" as part of their name. Examples include *bed bugs, chinch bugs,* and *water bugs. Junebugs, ladybugs,* and *tumblebugs* belong to the beetle family. They are not true bugs.

The two pairs of wings on bugs are not the same. The back wings are entirely membrane, and the front wings have membrane tips on a hard base. When the insect is at rest, the tips of the front wings cross and often appear to form an "X" on the insect's back.

Bugs lay their eggs in a variety of places, such as inside plant tissues, on plants, or glued to hairs. The eggs are oddly shaped and some have attractive colors. Some bugs injure crops, or attack people or other animals, but most are harmless. Bugs are usually controlled with insecticides, though other insects may provide the best control. Candace Martinson

See also **Bed bug; Chinch bug; Insect; Lovebug; Stink bug; Water bug.**

Buganda. See Uganda (History).

Bugbane is a tall plant with large, broad leaves divided into many leaflets. It has clusters of small white flowers. Bugbanes are *perennials* (plants that can live more than two years), and they grow in north temperate regions.

Prato, Bruce Coleman Ltd.

The bugbane is a tall plant with large, broad leaves. This perennial plant grows clusters of small white flowers.

The name originally referred to a kind of bugbane from Asia and eastern Europe. This plant has an unpleasant odor. People used its roots and leaves for medicine and to repel bugs and other insects. George Yatskievych

Scientific classification. Bugbane belongs to the crowfoot family, Ranunculaceae. It makes up the genus *Cimicifuga*.

Bugle is a wind instrument that consists of a curved brass or copper cone-shaped tube. It has a cup-shaped mouthpiece at one end and a *bell* (flared opening) at the other end. A bugle player produces tones by vibrating the lips while blowing into the mouthpiece.

Unlike most wind instruments, traditional bugles have no valves or keys. Different tones are produced on valveless bugles by changing the tension of the lips. Many buglers have difficulty blowing more than eight different tones on a valveless bugle. However, military calls, such as reveille and taps, are easy to learn and play because only a few notes are used. Some armies still use the bugle to give certain orders to large groups of soldiers.

WORLD BOOK photo by Ralph Brunke

The bugle is a wind instrument made of brass or copper. A common type of bugle is the soprano bugle, *shown here*.

In the 1800's, valves were first added to the bugle, allowing a larger range of tones to be played. Today, three-valved bugles are most common in drum and bugle corps. These modern bugles can play melodies in different keys. The bugles are made in sizes ranging from the piccolo (the smallest) to the contrabass (the largest).

The bugle dates back more than 2,000 years. It was first used as a hunting and signal instrument. The instrument was originally a straight cone-shaped tube, but its design changed into an S shape. By the 1700's, it was shaped in a semicircle and later was coiled. In the early 1800's, a bugle with keys similar to those of a saxophone became an important band instrument. However, the cornet soon replaced this instrument. The bugle was first used in military bands in the 1700's. Stewart L. Ross

See also **Drum and bugle corps**.

Buick, David Dunbar (1854-1929), was a pioneering automobile manufacturer. He organized the Buick Motor Company in 1903, and the company's first automobiles were built and tested that year.

Buick's automobiles were among the first to have valve-in-head engines. In valve-in-head engines, the valves are above the pistons, making possible a more complete intake of gasoline and better combustion. Eugene C. Richard, a Buick company engineer, designed the engine, while Buick designed the framework for the first Buick automobile. Financial problems caused Buick to leave the company in 1908. He later worked for oil and gold-mining companies.

Buick was born in Arbroath, Scotland, on Sept. 17, 1854. He moved to Detroit with his parents when he was 2 years old. Before making automobiles, Buick made plumbing supplies. He patented a process for bonding porcelain to iron and used the process to make porcelain bathtubs and other plumbing fixtures that soon became common household items. Buick then briefly operated a company that produced gasoline engines for farm and stationary equipment. He died on March 6, 1929. William L. Bailey

Building code. See Building permit.

Building construction. The construction of the homes and buildings in which people live and work has been a major industry ever since early human beings first made huts of sticks, mud, and rocks. Methods of building construction have been constantly improved since those first crude structures.

India's Taj Mahal required 20,000 workers and took from 1632 until 1653 to complete. Modern skyscrapers are usually completed within two to four years. *Prefabricated* buildings, with their various parts made in factories by assembly-line methods, can often be put together within a day or two. Buildings are built as places of residence; for business offices, manufacturing, and storage; and for worship, education, and other purposes.

Parts of a building

A building has two main parts, the *substructure* (the part below ground) and the *superstructure* (the part above ground). The substructure is usually called the

Cameramann International, Ltd.

WORLD BOOK photo by Dan Miller

Types of construction may vary according to a building's height. The skyscraper on the left has a skeleton construction made up of beams, columns, and girders. The structure on the right has a bearing-wall construction, which is used on most buildings less than four stories high.

foundation. It includes the basement walls, even though these may extend above the ground.

Both the substructure and the superstructure help to support the *load* (weight) of the building. The *dead load* of a building is the total weight of all its parts. The *live load* is the weight of the furniture, equipment, stored material, and occupants of a building. In some regions, the *wind load* of a building is important if the structure is to withstand storms. The *snow load* and earthquake shocks may also be important factors.

Foundations are the chief means of supporting a building. They carry both the dead and live loads. There are four main types of foundations: (1) spread, (2) pier, (3) pile, and (4) mat, or raft.

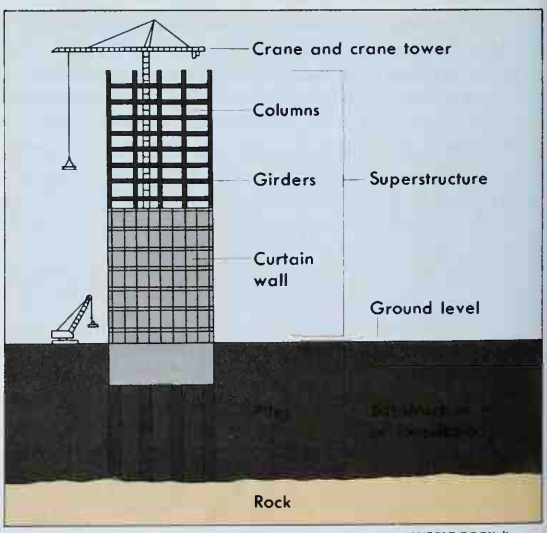
Spread foundations are long sections and rectangular slabs of reinforced concrete that extend beyond the outer edges of the building and under its walls and columns. Such foundations are not so firm as those based on solid rock. The footing areas in contact with the soil must be of sufficient size to spread the load safely over the soil and to avoid excessive or uneven settlement that would cause walls to crack or doors to bind.

Pier foundations are heavy columns of concrete that go down through the loose topsoil to a bed of firm rock. This bed may also be sand, gravel, or firm clay. If the bed consists of firm clay, the pier is usually *belled out* (enlarged) at the base, to increase the bearing area.

Pile foundations are long, slender columns of steel, concrete, or wood. Machines called *pile drivers* hammer them down as deep as 200 feet (61 meters) to a layer of solid soil or rock. Workers can tell when the columns reach their proper depth by the number of blows the pile driver needs to drive the columns 1 inch (2.5 centimeters). These columns transmit the building load to the supporting soil. Most skyscrapers are supported by rock foundations.

Mat foundations, also called *raft foundations,* are thick slabs of reinforced concrete that span the whole area beneath a building. They are normally used in poor soil conditions where it is not possible or economical to drive piles or piers down to good soil or rock. In effect, they enable the building to "float" on the soft soils. In some water-bearing soils, the foundation and superstructure must be heavy enough to keep the building from actually floating up from the ground.

Beams, girders, and columns support a building much like bones support the body. They form the skele-



WORLD BOOK diagram

The building construction of a skyscraper is shown in the above diagram. Most skyscrapers are built on rock and have pile foundations and skeleton frameworks.

ton of the superstructure, and bear the weight of the walls and each floor of the building. *Beams* and *girders* run horizontally. Girders are usually larger than beams. Closely spaced beams are called *joists,* especially in wooden buildings. *Purlins* are small beams that brace rafters or girders and help provide the structure to support roofs. Beams above window and door openings are called *lintels. Slabs* are beams whose width is greater than their depth.

Columns are heavy vertical supports that carry the load of beams and girders. *Trusses* consist of wood or steel supports that are connected in triangular patterns. The trusses provide the strength and rigidity to span large distances with relatively small amounts of material. *Arches* are curved supports that usually extend over openings.

Types of construction

In *bearing-wall construction,* the walls transmit the load to the foundation. In *skeleton construction,* all loads are transmitted to the foundation by a rigidly constructed framework made up of beams, girders, and columns. This skeleton carries the roof, walls, and floors, together with their loads. Bearing-wall construction is usually most economical for buildings less than four stories high, but skeleton construction is better for taller buildings. All buildings in the *skyscraper* class are of skeleton construction. *Shear walls* are used in both types of construction. They are designed to withstand wind, earthquakes, explosions, and other horizontal loads. They are generally made of solid concrete or *masonry* (precast concrete blocks).

Many parts of a building have no structural function. *Nonbearing walls* and *curtain walls* carry only their own weight and serve to divide the interior of a building or to keep out the elements. Such walls are called *nonbearing partitions.* Other nonbearing parts include windows, doors, stairs, elevators, and other equipment.

In one method of construction, called *tilt-up construction,* concrete wall panels are formed at ground level. Cranes or derricks then lift them into position.

Classification of buildings

Buildings are classified by construction as *fire-resistive, noncombustible, ordinary,* or *frame.* The most important factor in this classification is resistance to fire. A *standard fire test* is used in testing samples of materials. In this test, the samples are exposed to a fire of specified intensity. The materials are graded for their ability to withstand the fire. For example, a two-hour rating is given a material that withstands the test for two hours.

Fire-resistive construction is that in which the walls of a building are of masonry or reinforced concrete, and the major structural parts are steel or reinforced concrete and so insulated as to have a four-hour rating. Other parts of the building must have a three-hour rating. Large cities require most buildings in the business districts to be fire-resistive.

Noncombustible construction is similar to fire-resistive construction. However, the major structural parts have a two-hour rating.

Ordinary construction is that in which the exterior walls are masonry or reinforced concrete, and in which the interior structural members are partly or entirely of wood in smaller dimensions than required for heavy timber or steel construction.

Dayton Superior Corporation

The tilt-up method of construction, *shown here,* involves forming concrete wall panels at ground level. The panels are then lifted into position by cranes or derricks.

Frame construction is that in which exterior walls are wholly or partly of wood. It includes brick or stone veneer, stucco, or sheet metal over wood.

Constructing a skyscraper

New methods in the design and construction of skyscrapers have been closely related to the development of computers. Engineers use computers to solve the complex mathematical problems involved. Computers do this work so quickly that engineers have more time to create new designs and construction methods.

When an organization decides to erect a skyscraper, it usually signs a contract with a building firm. The company awards the contract after many firms have submitted bids showing the price they will charge and the time they will need to erect the building. The company that receives the contract must make detailed building plans so that construction can be done as quickly and cheaply as possible. The construction firm often *subcontracts* to other companies for such work as electrical wiring, plumbing, and bricklaying. Such subcontracting saves money because it means using workers only when the production schedule requires them.

Before construction begins, engineers determine the kinds of soils underneath the new building. With this information, they can design the proper foundation. After the building site is cleared, leveled, and drained of water, *excavation* (digging) begins. Large loaders or hydraulic excavators usually excavate the foundation of the building. Ground that is made of rock may be excavated by blasting.

Sometimes workers dig a trench on all sides of the foundation and fill it with concrete before excavation begins. Any excavation that may cave in is braced and shored with wood or steel. Pumps can be used to keep

R. S. Uzzell III, Woodfin Camp, Inc.

Prefabricated buildings consist of entire sections that are produced in factories. This photo shows a crane hoisting a prefabricated wall into position at the construction site.

water from the excavation area at all times. But if the soil becomes too watery, *caissons* (protective walls) may be built so the work can continue (see **Caisson**).

After the excavation is finished, the *footings* (base) and the superstructure are built. Most steel used in the superstructure, such as beams, girders, and columns, comes prefabricated. Each piece of steel has a number indicating the exact place where it should be used. When the steel is raised into place, workers fasten the pieces together temporarily with bolts. Later, welders or bolt-up crews join these pieces permanently.

Many kinds of derricks and cranes are used in the construction of skyscrapers. The two main kinds are *mobile cranes* and *tower cranes*. Mobile cranes are mounted on trucks or special vehicles and can maneuver around the outside of the building to hoist materials and equipment from various locations. Tower cranes are supported on a steel tower erected next to or inside a building's framework. They can only hoist materials positioned within the maximum radius of their lifting mechanisms. Some tower cranes can add sections to increase the height of their support tower as the building goes up. Others are mounted directly on the recently constructed upper stories of the building's framework. They can use a telescoping mechanism to raise up with successive floors as they are constructed. A derrick, mobile crane, or even a helicopter can help in removing sections of a tower crane once the building is nearly complete.

Workers in the United States and other countries commonly celebrate the placement of the uppermost part of the framework with a *topping out ceremony*. They usually attach an evergreen tree and a flag to this part before hoisting it up the side of the building.

After workers complete the superstructure and outside walls, the building is ready to be finished, decorated, and furnished. These steps are much like finishing a house (see **House**).

Prefabricated construction

Prefabrication has become an important part of all types of building construction. Prefabricated sections of a building are produced in large quantities in a factory and then shipped to various construction sites. This procedure allows work to continue despite poor weather conditions and reduces any waste in time and material at the site. As a result, costs are lowered and construction time decreases.

Many types of building sections can be prefabricated. For example, entire walls may be prefabricated for a wooden frame house. Huge wooden arches are prefabricated for use as supports in churches, gymnasiums, and other buildings. Concrete beams, floors, roofs, and wall panels may be *precast* for many types of structures. Entire buildings may be constructed in a factory and then transported to the desired location.

Prefabricated structures are sometimes made by a process called *modular construction*. Modular construction refers to the use of a standard measurement as the basis for all building materials. In the United States, the basic *module* (unit size) is 4 inches (10 centimeters). All building parts are designed so that each dimension either equals this measurement or some multiple of it. Such standardization of building parts allows all parts to fit together with few or no alterations. Modular parts are also used in buildings that are not prefabricated.

Matthew A. Dettman

Related articles in *World Book* include:

Building materials

Adobe	Cement and concrete	Insulation	Plastics
Aluminum	Clay	Iron and steel	Putty
Brick	Glass	Lumber	Terra cotta
Building stone		Nail	Tile
		Paint	Wallboard

Other related articles

Architecture	Cofferdam	Materials
Building permit	Crane	Pile
Careers (Construction, maintenance, and repair)	Escalator	Roof
	Flooring	Shelter
	Heating	Skyscraper
Carpentry	House	Window
	Housing	

Building permit is a license authorizing the construction of any building within the boundaries of an incorporated community. Sometimes building permits are needed for structures within a certain distance outside these boundaries. The main purpose of a building permit is to allow city officials to decide whether the proposed structure meets community standards. The officials want to make sure that the structure is of a type authorized by the building code. They also want to determine whether it violates any zoning law or infringes on any deed or ordinance restriction. The officials decide whether the construction meets safety standards and other requirements. They can inspect the property during and after construction to make sure the builders have not violated the permit.

Zoning divides a community into districts. It regulates the height and size of buildings and the balance between the size of each lot and the size of the building on it. Zoning also attempts to keep the same types of building uses grouped together. For example, all commercial buildings are normally grouped together.

If the application conforms to all the requirements, a building permit may be issued upon payment of a fee. This permit does not compel the property owner to

erect the building, or complete its construction. It only gives the owner legal permission to do so within a given period of time, usually a year. But if the structure does not conform to all the requirements, the property owner may be required to complete it or remove it.

A *building code* is a group of ordinances that establishes regulations for the construction, remodeling, repairing, and maintenance of a structure. Building codes usually apply only within the boundaries of the community that enacts the code. A person must obey the community's building code whether the structure involved is a small addition onto a home or the construction of a big office building. Oscar Newman

See also **City planning** (Governmental authority); **Zoning.**

Building stone is one of the world's most important construction materials. It comes from natural stone deposits in the earth and is mined through *quarrying.* Building stone is used as crushed or broken stone called *crushed stone,* or as *dimension stone.* Dimension stone is cut from large blocks and slabs into definite shapes and sizes.

Crushed stone accounts for about 99 percent of all building stone. In highway construction, it is blended with tarlike substances such as asphalt to produce the type of pavement called *blacktop.* Crushed stone is also mixed with portland cement and sand to make concrete used in building foundations, frames and floors; streets; airfield runways; conduit blocks; and panels.

Dimension stone is used most often for finishing and decorating all types of structures. Constructors expect good dimension stone to last more than 100 years. The best dimension stone has few pores or air cells. Stone with open pores may chip and break if water freezes and expands in the pores. Dimension stone includes granite, limestone, sandstone, marble, and slate.

Eric Carle, Shostal

Workers mine limestone from a quarry in Indiana, *shown here.* Limestone is durable and can be cut and shaped easily. It is often used to make trims and facings for buildings.

Granite is one of the strongest building stones. But it is difficult to cut and handle because it is so hard. It is used in the construction of many public buildings. Granite can be polished to a glossy finish and is an excellent background for carvings and lettering.

Limestone is a hard and lasting building stone that can be cut easily and shaped with saws, planes, and even lathes. These buff or gray stones are sometimes placed over the rough stonework of a building to make an attractive surface. Limestone is also used to tile floors, and for sills, steps, and trimming.

Sandstone is easy to work and is used for the same purposes as limestone. Sandstone that is well-cemented with silica is probably more durable and weather-resistant than most other building stones.

Marble is the most elegant building stone. Pure marble is white, streaked with veins of black, gray, green, pink, red, and yellow. Builders use marble to make monuments and tombstones, and to decorate stairways, hearths, floors, and as paneling.

Slate is fine-grained rock that can be split easily into thin slabs and used for roofing shingles and flagstone flooring. LeRoy T. Boyer

Related articles in **World Book** include:

Building construction
Granite
Limestone
Marble
Quarrying
Sandstone
Slate

Building trade is any one of the branches of a large section of industry concerned with the construction of public buildings, homes, bridges, canals, harbors, railways, reservoirs, streets and highways, sewers, and subways. Together, the building trades are known as the construction industry.

Divisions of the building trades

The planning branches of building-construction work include the services of architects, engineers, and contractors. Other branches of the building trades include earthwork, or foundation construction; tunneling; structural-steel erection; sheet-metal work; masonry, or the construction of brick, concrete, or tile structures; glass installation; woodworking; roofing; painting and decorating; and the mechanical trades, which include the installation of electrical, plumbing, heating, and ventilating equipment.

The contracting system

A building or other construction project may be erected by an individual or an organization that develops the plans, hires the laborers, and buys the materials directly. But most construction work is turned over to a *general contractor.* The contractor agrees, in a written *bid* or *proposal,* to complete the building according to the plans and specifications of the architect and engineer. The price may be a fixed *lump sum,* or the contractor may agree to construct the building for whatever it costs plus a *fixed fee,* or a *percentage,* of the building cost. The general contractor may do all or a large part of the work. Usually, however, the contractor makes use of *subcontractors,* who furnish the labor and materials for certain parts of the work, such as the excavating or

carpentry. The subcontractors also receive a fee or percentage for their work. The general contractor usually employs a *superintendent* who supervises the actual construction activity, including the work of the subcontractors. The architect, or someone chosen by the architect, makes certain that the structure is built according to the plans and specifications.

A construction project usually must be completed by a certain date in order that business plans can be made and carried out. For this reason, a *time schedule* is usually prepared before the construction work begins. The schedule gives the starting date, the required rate of progress, and the date of completion for the various kinds of work to be done by the subcontractors.

Career opportunities

Almost all the workers in the building industry are members of skilled trades. Workers in the various trades are usually organized into unions, which work to improve wages and working conditions and to secure other benefits for the workers. The principal kinds of skilled workers in the building trades include bricklayers, carpenters, electricians, ironworkers, painters, plasterers, plumbers, and steam fitters.

Bricklayers learn their trade as apprentices to experienced bricklayers, or at vocational or technical schools. Bricklayers must be able to read blueprints. They can become supervisors or contractors.

Carpenters. There are two types of carpenters, those who do *rough* work and those who are *finishers*. The *rough-work* carpenter builds framework and makes forms into which cement or concrete is poured. The *finisher* does such work as hanging doors and windows and putting locks and doorknobs into place. A rough-work carpenter must be strong, because the work is heavy. Carpenters usually learn their trade as apprentices. They may later become carpentry contractors.

Electricians usually begin their trade by helping with wiring work on construction jobs. Experienced electricians install switchboards, meters, electric-outlet boxes, and other electrical equipment. Electricians must understand architects' drawings and principles of physics. They may receive training as apprentices, or in high schools or vocational or technical schools. After many years of experience, electricians may become electrical contractors.

Ironworkers work both indoors and outdoors. The ironworker erects beams, trusses, and girders in the framework of a building. Ironworkers must be able to read blueprints, and must have some knowledge of mathematics and the science of metals.

Painters work on both the outside and the inside of construction projects. Painters learn their trade by working with experienced painters and may eventually become painting contractors.

Plasterers finish interior walls and ceilings. The plasterer usually learns the trade as an apprentice and may become a job supervisor or subcontractor.

Plumbers install water, gas, and sewer systems. They also install bathroom, kitchen, and laundry equipment. Many plumbers go into business for themselves after several years working at their trade.

Steam fitters install heating and air-conditioning systems and refrigeration equipment. The steam fitter learns the trade as an apprentice or in a vocational or technical school. Many steam fitters become heating or air-conditioning contractors.

Matthew A. Dettman

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Air conditioning
Building construction
Careers (Construction, maintenance, and repair)
Carpentry
Fireproofing
Heating
House
Interior design
Plaster
Plumbing
Ventilation

Bujumbura, *boo juhm BUR uh* (pop. 151,000), is the capital and largest city of Burundi. It lies in the western part of the country, along the northeast shore of Lake Tanganyika. For location, see **Burundi** (map).

Most of Burundi's government activity takes place in Bujumbura. The city is also a trading center and a center for shipping on Lake Tanganyika. An international airport serves Bujumbura. The city has a university, an agricultural institute, and a museum.

Bujumbura formerly was called Usumbura. German troops founded the city as a military post in 1896, when the Burundi area was part of German East Africa. In 1919, Usumbura became the capital of Ruanda-Urundi, a Belgian-controlled territory that is now Burundi and the neighboring country of Rwanda. Burundi gained independence in 1962, and the city became the nation's capital. The city's name was changed to Bujumbura that same year.

Stephen K. Commins

Bulawayo, *boo luh WAH yoh* (pop. 620,000), is the second largest city and a major industrial center of Zimbabwe. Only Harare, the capital, is larger. Bulawayo lies on the Matsheumhlope River, in southwestern Zimbabwe. For location, see **Zimbabwe** (map).

Bulawayo has many parks and modern buildings and is the home of several colleges. The Zimbabwe Museum of National History is in the city. Bulawayo's industries manufacture building materials, radios, textiles, tires, and other products.

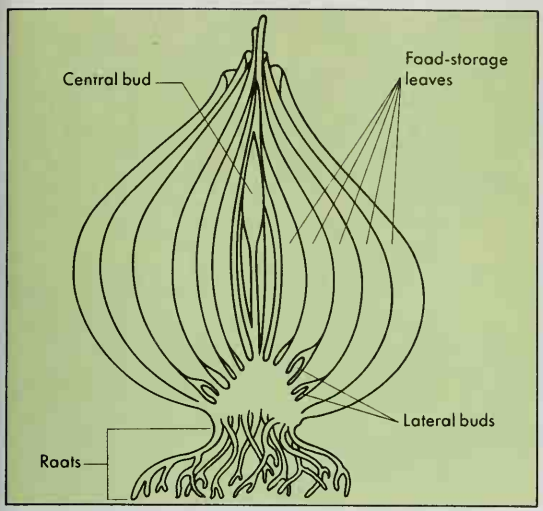
During the mid-1800's, an African people called the Ndebele settled near the site of present-day Bulawayo. In 1893, forces hired by the British South Africa Company drove the Ndebele from the area and established a town there. Bulawayo became a city in 1943.

John D. Metzler

Bulb is a round, underground structure that develops in certain flowering plants. A bulb consists largely of layers of thick, fleshy leaves. These surround a small piece of stem tissue, which produces a large bud near the center of the bulb. Roots grow from the bottom of the bulb.

The chief function of a bulb is food storage. During the growing season, the plant stores food in the fleshy leaves of the bulb. As the winter or dry season approaches, the aboveground parts of the plant die, but the bulb with its stored food remains alive underground. At the beginning of the next growing season, the bulb's central bud sends out a shoot, which produces a stem, leaves, and flowers above the ground. The stored food fuels the young shoot's rapid growth.

Bulbs also have *lateral,* or branch, buds that develop into new bulbs. Gardeners frequently separate branch bulbs and replant them to produce new plants. This type of reproduction is known as *vegetative propagation* (see Plant [Vegetative propagation]). Most bulb-forming



WORLD BOOK illustration by Zorica Dabich

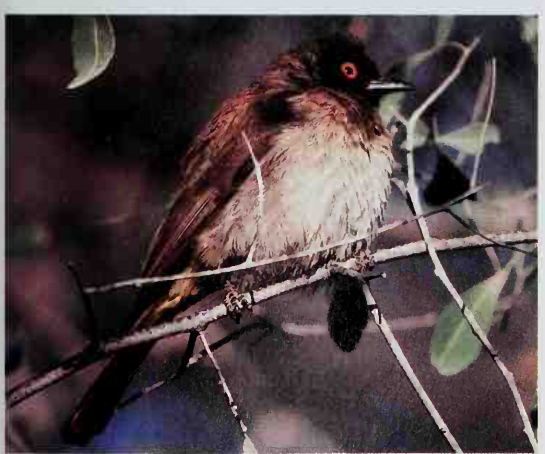
A bulb stores food for plant growth in layers of fleshy leaves. The central bud will produce an aboveground stem, leaves, and flowers. The lateral buds will grow into separate bulbs.

plants also reproduce by means of seeds produced in their flowers.

Onions and garlic are familiar bulbs used for food and flavoring. Garlic bulbs consist mostly of many separate segments called *cloves*. Each clove is a lateral bud surrounded by a few fleshy storage leaves. Such popular garden flowers as tulips, daffodils, and narcissuses grow from bulbs that people plant in the fall. People sometimes use the word *bulb* to refer to *corms*. Corms resemble bulbs but consist mostly of stem tissue with a few thin, scaly leaves. Richard C. Keating

See also Corm; Flower (Garden perennials [Bulbs]).

Bulbul is any member of a family of about 120 species of tropical songbirds found in Africa and southern Asia. Bulbuls are small to medium-sized, and most have slender, notched bills. They have loose, fluffy feathers, and some species have a crest of feathers on the head. Most bulbuls are dully colored, with combinations of yellow, green, brown, or gray feathers. However, some species have patches of bright red or yellow feathers on the head or beneath the tail.



E. R. Degginger

The bulbul is a tropical songbird.

Most types of bulbuls have loud, lively songs. Some species are familiar inhabitants of gardens and yards, but others live only in dense jungles and are seldom seen. Bulbuls use twigs and small roots to build cup-shaped nests in bushes or trees. The female lays from two to four eggs, which, in most species, are pinkish-white marked with brown, chestnut, or violet. Bulbuls eat chiefly fruits and insects. Some species roam in large, noisy flocks when they are not raising their young. Robert B. Payne

Scientific classification. Bulbuls make up the family Pycnonotidae.

Bulfinch, Charles (1763-1844), is generally considered New England's greatest architect. Bulfinch's buildings show the influence of classical simplicity and restraint. He helped introduce the Federal style, which dominated American architecture until 1820.

Bulfinch's designs include churches, homes, and public buildings, including the statehouses of Connecticut, Maine, and Massachusetts. For pictures of these buildings, see **Connecticut** (Connecticut in brief); **Maine** (Maine in brief); and **Architecture** (Early American architecture). Bulfinch served as an architect for the Capitol in Washington, D.C. His most influential works were the beautiful houses he designed on Boston's Beacon Hill and in other New England towns. Bulfinch was born in Boston. Thomas Bulfinch, his son, was a popular writer. Leland M. Roth

Bulfinch, Thomas (1796-1867), was an American writer who became famous for his popular retelling of myths and legends for young people. Bulfinch's most important book was *The Age of Fable* (1855). The book has introduced generations of young readers to the mythology of ancient Greece and Rome as well as to Celtic, Scandinavian, and Asian mythology. Bulfinch's *The Age of Chivalry* (1858) deals with legends about King Arthur. *Legends of Charlemagne* (1863) retells legends of the Middle Ages. The three books are commonly known as *Bulfinch's Mythology*.

Bulfinch was born in Newton, Massachusetts. He was the son of the American architect Charles Bulfinch. He worked for a bank for 30 years and did not begin his literary career until he was 57 years old. Edward W. Clark

Bulganin, *bul GAH nihn,* **Nikolai Aleksandrovich,** *nih kah LY AH leh KSAHN drah vihch* (1895-1975), was premier of the Soviet Union from 1955 to 1958, when Nikita S. Khrushchev replaced him. Bulganin was demoted to chairman of an economic council. As premier, Bulganin headed the Soviet government in name only. Khrushchev, secretary of the Communist Party, held real power. With Khrushchev, Bulganin made many trips to other countries between 1955 and 1957. He wrote to Western powers in December 1957, warning the North Atlantic Treaty Organization (NATO) conference against permitting missile bases in Western Europe.

Bulganin was born in Nizhniy Novgorod. He became a Bolshevik in 1917, and served in the secret police from 1918 to 1922. Bulganin later served as the mayor of Moscow. He organized civilians to defend Moscow during World War II. Though not a military man, Bulganin became a general and then a marshal. Albert Marrin

Hans Kramarz

Farmland covers more than half of Bulgaria. It separates the country's many mountainous areas. The Balkan Mountains, *shown here,* rise in the background.

Bulgaria

Bulgaria, *buhl GAIR ee uh,* is a country on the Balkan Peninsula of southeastern Europe. It is bordered by Romania on the north, Yugoslavia and Macedonia on the west, Greece and Turkey on the south, and the Black Sea on the east. Mountains cover most of Bulgaria. Fertile valleys and plains separate the mountains in a large number of areas.

Until the late 1940's, a majority of Bulgarians lived in rural areas and worked on farms. Today, most of Bulgaria's people live in cities. Many work in such industries as food processing and production of metal goods. Sofia is the capital and largest city of Bulgaria.

About 3,000 years ago, a people called the Thracians established the first civilization in what is now Bulgaria. The region became part of the Roman Empire during the A.D. 40's. Between the late 600's and the mid-1300's, Bulgaria twice ruled a powerful kingdom that covered most of the Balkan Peninsula. In the late 1300's, the Ottoman Empire conquered the country. Russia helped Bulgaria gain freedom from Ottoman rule in 1878. The country became fully independent in 1908.

Government

Bulgaria came under Communist rule in 1946. The Bulgarian Communist Party took control of the government. Political parties that opposed the Communist Party were outlawed. The party and government together gained almost total control over the economy. The party also attempted to control all social aspects of life, such as religion and entertainment. It placed strict restrictions on such basic rights as freedom of speech.

In the late 1980's, the Soviet Union, which was then the world's most powerful Communist country, made reforms resulting in more freedom for its people. Reform movements then increased in Bulgaria and other European Communist countries. In December 1989, Communists who favored reforms gained control of Bulgaria's Communist Party and the government. They began taking steps to end the party's complete control of the government. Opposition parties were allowed to operate. The Communist Party changed its name to the Bulgarian Socialist Party.

National government. The National Assembly is Bulgaria's legislative body. Its 240 members are elected by the people to a four-year term. The political party that has a majority of seats in the National Assembly chooses a prime minister, who is Bulgaria's most powerful government official. The prime minister heads a cabinet, called the Council of Ministers, which carries out operations of the government. The voters elect a president to a five-year term. The president is commander in chief of the armed forces and has legal and administrative duties. All Bulgarians 18 years of age or older may vote.

Local government. Bulgaria is divided into 100 administrative regions. One city, Sofia, ranks as an administrative region. Each administrative region is governed by an official elected by the people. Below the regional level of government are more than 1,100 urban and rural

Facts in brief

Capital: Sofia.
Official language: Bulgarian.
Official name: Republika Bulgariya (Republic of Bulgaria).
Area: 42,823 mi² (110,912 km²). *Greatest distances*—east-west, 306 mi (492 km); north-south, 170 mi (274 km). *Coastline*—175 mi (282 km).
Elevation: *Highest*—Musala Peak, 9,596 ft (2,925 m) above sea level. *Lowest*—sea level.
Population: *Estimated 2002 population*—8,128,000; population density, 290 per mi² (73 per km²); distribution, 68 percent urban, 32 percent rural. *1992 census*—8,472,724.
Chief products: *Agriculture*—wheat, corn, barley, sugar beets, grapes, tobacco, milk. *Manufacturing*—machinery, processed foods, metal products, textiles. *Mining*—salt, sulfur, lead, kaolin, copper.
National anthem: "Mila Rodino" ("Dear Homeland").
Money: *Basic unit*—lev. One hundred stotinki equal one lev.

communities. Each community is governed by an official appointed by an elected people's council.

Courts. The High Judicial Council is Bulgaria's highest court. It hears appeals from lower courts and rules on the constitutionality of issues. This court has 11 members appointed by the National Assembly, 11 appointed by other judicial authorities, and 3 appointed by the president. Bulgaria's lower courts include a Supreme Court of Appeals; a Supreme Administrative Court; and regional, district, and appeals courts. The military has its own courts.

Armed forces. Bulgaria's regular army, air force, and navy together have about 100,000 members. Men 18 years of age and older may be drafted into the armed forces for 18 months.

People

Ancestry. About 85 percent of the people of Bulgaria are of Bulgarian ancestry. They are descended from Slavs, who settled the region in the 500's, and Bulgars, who arrived in the 600's. The Slavs came from what are now southeastern Poland and northwestern Ukraine. The Bulgars were a nomadic Asian people.

People of Turkish ancestry make up about 10 percent of the population of Bulgaria. In 1984 and 1985, Bulgarian authorities forced the Turks to adopt Bulgarian names. Some of the people who refused to change their names were killed by Bulgarian troops. Others were forced to leave the country. In December 1989, Bulgaria's reform government ended this policy and granted equal rights to ethnic Turks. Other minority groups in Bulgaria include Armenians, Greeks, Gypsies, Romanians, and Russians.

Symbols of Bulgaria include a flag that bears the national colors—white, green, and red. The country's coat of arms, adopted in 1997, features a shield and a crown, flanked by lions.

WORLD BOOK map

Bulgaria lies on Europe's Balkan Peninsula. It borders the Black Sea, Romania, Yugoslavia, Macedonia, Greece, and Turkey.

Hans Kramarz

A crowded square in Sofia, Bulgaria's capital and largest city, reflects the rapid growth of Bulgarian cities since the 1940's.

Way of life. Before Communist rule began in 1946, most Bulgarians lived in rural areas, where poverty was widespread. After the Communists came to power, the government began to industrialize Bulgaria. Many people then moved to cities to work in factories.

Today, a majority of Bulgaria's people live in urban areas. Although living conditions have improved in the country, Bulgaria still has one of the lowest standards of living in Europe.

Most of Bulgaria's city workers are employed by factories and businesses. About 80 percent of all Bulgarian women work outside the home. They make up nearly half the total work force. Wages are low, and jobs are scarce. Shortages of housing, food, and basic goods keep prices high. Most city dwellers live in apartments that lack many of the comforts common in Western countries. Few people can afford a car, but many Bulgarians own a television and a radio. Many goods sold in Bulgaria are of poor quality.

In rural areas, most people work on farms. Most rural people live in simple houses that, in many cases, lack such conveniences as central heating and plumbing. The government has improved conditions by building paved roads and providing electric power and telephone service in many rural communities.

Recreation and food. Bulgarians enjoy informal gatherings with friends or relatives. They also like walking. Movies, books, music, and dance styles from Western countries are popular, especially with young people. Sporting events, particularly soccer matches, attract many spectators. Many vacationing Bulgarians flock to the Black Sea coast to enjoy the mild weather and the beautiful beaches.

Bulgarians enjoy simple stews and other dishes that contain lamb, pork, or beef. Yogurt is a popular part of their diet. Strong plum brandy is a favorite alcoholic drink.

Language. Bulgarian, the official language of Bulgaria, is spoken by most of the people. Bulgarian is

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Pazardzhik	82,578	D 3
Pernik	90,586	C 1
Peshtera	19,280	D 3
Petrich	27,659	E 2
Pleven	130,812	B 3
Plovdiv	341,058	D 3
Popovo	19,722	B 5
Pŭrvomay	16,809	D 4
Radomir	16,909	C 1
Razgrad	40,933	B 5
Ruse	170,038	A 5
Samokov	28,608	D 2
Sandanski	26,096	E 2
Sevlievo	25,494	C 4
Shumen	93,292	B 6
Silistra	48,360	A 6
Sliven	106,212	C 5
Smolyan	34,086	E 3
Sofia	1,114,925	C 2
Stanke Dimitrov	41,398	D 2
Stara Zagora	150,518	C 4
Svilengrad	18,643	D 5
Svishtov	30,404	B 4
Troyan	25,104	C 3
Türgovishte	43,016	B 5
Varna	308,432	B 7
Veliko Türnovo*	63,580	B 4
Velingrad	25,634	D 2
Vidin	62,691	A 1
Vratsa	75,518	B 2
Yambol	91,561	C 5

Physical features

Aleksandr Stamboliyski Reservoir		B 4
Arda River		E 4
Balkan Mountains		C 2
Black Sea		C 7
Botev (mountain)		C 3
Cape Emine		C 7
Cape Kaliakra		B 7
Danube River		A 1
Dobriya Mountains		A 6
Fakiyska River		D 6
Gulf of Burgas		C 6
Iskŭr River		B 2
Kamchiya River		C 6
Macedonia (region)		E 1
Maritsa River		D 4
Mesta River		E 2
Musala (mountain)		D 2
Ogosta River		B 2
Pirin Mountains		D 2
Rhodope Mountains		D 2
Rujen (mountain)		D 1
Sredna Gora (mountains)		C 2
Struma River		D 1
Tundzha River		D 5
Vucha River		D 3
Yantra River		B 4

*Source: 1992 census, except for asterisked items, which have 1987 official estimates.

closely related to Russian and other Slavic languages and is written in the Cyrillic alphabet (see **Alphabet** [The Cyrillic alphabet]).

Education. Almost all Bulgarians aged 15 or older can read and write. The government operates most schools in Bulgaria. Children are required to attend eight years of elementary school. They study such subjects as history, literature, mathematics, and art. Nearly all students go on to high school. Bulgaria has about 25 institutions of higher education.

The arts. The golden age of Bulgarian arts occurred in the 800's and 900's, when Bulgarian artists and craftworkers created magnificent Byzantine churches, paintings, and religious objects (see **Byzantine art**). Bulgarian literature flourished in the 1000's. The Ottoman Empire conquered the country in the late 1300's. The arts then declined. Ottoman rule of Bulgaria weakened in the 1800's, and the country's culture began to revive. Two of

Hans Kramarz

An outdoor market near Plovdiv attracts shoppers. The farmer above is selling garlic, a favorite Bulgarian seasoning.

Bulgaria's finest authors of the 1800's were the poet Khristo Botev and the novelist Ivan Vazov. Botev's fiery works called for freedom from Ottoman rule. Vazov vividly described the people's suffering under the Ottomans. After the Communist Party came to power, the government strictly controlled artistic expression. But since the reform government came to power in 1989, restrictions on the arts have been lifted.

Bulgaria is known for its performing arts, especially music. Several opera singers, including Boris Christoff and Nikolai Ghiaourov, have won international fame.

Religion. After the Communist Party came to power, the government discouraged religion and supervised religious practice. But in 1989, the reform government affirmed the rights of all citizens to practice their religion. About 90 percent of the people are members of the Bulgarian Orthodox Church, one of the Eastern Orthodox Churches (see **Eastern Orthodox Churches**). Other religious groups include Muslims, Protestants, and Roman Catholics.

The land

Bulgaria has four main land regions. They are (1) the Danubian Plateau, (2) the Balkan Mountains, (3) the Transitional Mountains and Lowlands, and (4) the Rhodope Mountains.

The Danubian Plateau covers northern Bulgaria from the Danube River south to the Balkan Mountains. Several Bulgarian rivers, including the Iskŭr and the Yantra, flow into the Danube. The Danubian Plateau has the country's most fertile farmland.

The Balkan Mountains cross Bulgaria from west to east. Botev Peak, which rises 7,795 feet (2,376 meters), is the tallest mountain in the range.

The Transitional Mountains and Lowlands lie south of the Balkan Mountains, between the Black Sea on the east and the Rhodope Mountains on the west and south. Farmers raise many fruits and vegetables in the region's Maritsa and Tundzha river valleys.

The Rhodope Mountains lie in southernmost Bulgaria. The country's highest point, Musala Peak, rises 9,596 feet (2,925 meters) above sea level in the range.

Climate

Bulgaria's climate varies from region to region because of differences in the terrain. In January, the average temperatures in the country range from 35 °F (2 °C) near the Black Sea to 0 °F (−17 °C) in central Bulgaria. In July, the average temperature is 75 °F (24 °C) throughout most of the country. The summers are humid in northern Bulgaria and dry in southern Bulgaria.

The average yearly precipitation in Bulgaria is 25 inches (63 centimeters). But mountain areas usually get more than 40 inches (100 centimeters) yearly. Snowfall is generally light except in the mountains.

Economy

Bulgaria is a developing country. Under Communist rule, its economy was based on government ownership of factories, mines, most farmland, and other resources used for production. Poor management and shortages of fuel and skilled labor slowed economic growth. When the reform government came to power in 1989, it redistributed much of the land in the large government-owned farms to private owners. It also began to sell state-owned companies to private owners.

Bulgaria's production is reported in terms of the country's *net material product* (NMP). The NMP is the total value of goods and of services used in the production of these goods by a country in a year.

Manufacturing, mining, and energy production account for about half of Bulgaria's net material product and employ about a third of the nation's workers. The top manufacturing industries make chemicals, processed foods, metal products, machinery, and textiles. Much of the technology used in manufacturing is outdated. Therefore, many of the country's products are not competitive in world markets. Many industries cannot operate without financial assistance from the government. Major industrial centers include Sofia, Dimitrovgrad, Plovdiv, Ruse, and Varna.

Bulgaria has small deposits of many minerals. The nation mines coal, copper, kaolin, lead, pyrite, salt, sulfur, and zinc. A nuclear power plant at Kozloduy provides about a third of the country's electric power. Bulgaria

Hans Kramarz

The Danubian Plateau covers northern Bulgaria. It has the country's best farmland. Factories in Ruse, *shown here,* Bulgaria's chief port on the Danube, process food grown in the region.

Hans Kramarz

Textile manufacturing is a major Bulgarian industry. The women above work in a textile factory in Plovdiv.

must import most of its fuel.

Service industries account for about a fifth of Bulgaria's net material product and employ about a third of all workers. The largest group of service industries provides community, social, and personal services, such as education and health care. Stores, restaurants, and hotels form another important group of service industries. Other service industries include transportation and communication.

Agriculture accounts for about a fifth of Bulgaria's net material product and employs about a fourth of the country's workers. Farmland covers about 15 million acres (6 million hectares), or more than half of Bulgaria.

Grain is Bulgaria's chief farm product. Wheat and corn are the leading grains. Other grains include barley, oats, rice, and rye. Farmers also grow a wide variety of fruits and vegetables, including apples, grapes, potatoes, pears, sugar beets, tomatoes, and watermelons. Tobacco and roses are also important crops. Roses are grown for their sweet-smelling oil, which is used to make perfume. Bulgarian farmers raise such livestock as dairy and beef cattle, chickens, pigs, and goats. Cow's milk is a major farm product.

Trade. Bulgaria's main trading partners include Germany, Greece, Italy, Russia, the United Kingdom, and the United States. Twice each year, a large trade fair is held in Plovdiv. Bulgaria receives financial aid from the European Bank for Reconstruction and Development. Founded in 1990, this bank was designed to help rebuild the economies of Eastern European countries.

Bulgaria's chief imports include fuels, industrial equipment, metals, and such raw materials as iron ore and coke. Its main exports include cigarettes and tobacco, grapes, machinery, rose oil, and wine.

Transportation and communication. About 2,700 miles (4,300 kilometers) of railroad track crisscross Bulgaria. The country also has about 22,660 miles (36,470 kilometers) of roads, but only about a fourth are paved. The main airports are in Sofia, Burgas, and Varna. Ruse is Bulgaria's chief port on the Danube River, the country's only important inland waterway. The leading ports on the Black Sea are Varna and Burgas.

Censorship no longer exists in Bulgaria as it once did under Communism. The Bulgarian Telegraph Agency, the nation's official news agency, provides foreign and national news. Both state-owned and privately-owned radio stations and TV networks broadcast in Bulgaria.

History

Early history. A people called the Thracians established the first civilization in what is now Bulgaria about 3,000 years ago. The region became part of the Roman Empire in the A.D. 40's. Slavs from what are now southeastern Poland and northwestern Ukraine settled in the territory during the 500's. In the 600's, nomadic Bulgar tribes from central Asia migrated to the region. In time, the Bulgars blended with the Slavic people.

The first Bulgarian kingdom was established in 681. It gradually became the most powerful state in the Balkans. Under Simeon I, who came to the throne in 893, Bulgaria entered a golden age. Simeon brought Albania, Macedonia, Serbia, and some other parts of the Byzantine Empire under Bulgarian influence. Trade, literature, and art flourished. After Simeon died in 927, Bulgaria's power began to decline. In 1018, the country was conquered by the Byzantine emperor Basil II and became part of the Byzantine Empire.

The second Bulgarian kingdom was founded in 1186, after Bulgaria regained its independence from Byzantine rule. In the 1200's, Bulgaria's economy and culture thrived again, and the country once more became a Balkan power. But invaders from the Ottoman Empire in central Asia began raiding Bulgaria in the early 1300's. By 1396, they had conquered the country.

Ottoman rule of Bulgaria lasted more than 500 years. The Ottomans forced their culture on Bulgarian society. They seized Bulgarian lands and other property and heavily taxed the people. The Ottomans killed many Bulgarians who opposed their rule.

The Bulgarians rebelled in the 1590's, the 1680's, and the 1730's. But the Ottomans crushed them each time. From the late 1700's through the mid-1800's, Bulgarian patriotism grew. The Ottomans made some social reforms, but the Bulgarians still wanted freedom. They revolted again in 1876 and were brutally put down.

In 1878, during a war between Russia and the Ottoman Empire, Russian troops invaded Bulgaria and defeated the Ottoman army. In March 1878, the Ottomans were forced to sign the Treaty of San Stefano and give up Macedonia and Thrace to Bulgaria. But in July, a meeting of European leaders called the Congress of Berlin replaced the treaty with the Treaty of Berlin. This treaty returned most of the territory to the Ottoman Empire and allowed for limited Bulgarian self-rule. See **Berlin, Congress of**.

In 1879, Bulgaria adopted a Constitution. Alexander of Battenberg, a German prince, was installed as Bulgaria's ruler. The next ruler, King Ferdinand, declared Bulgaria's full independence from the Ottoman Empire in 1908.

The Balkan wars. In 1912, Bulgaria joined other Balkan states in a war to drive the Ottomans out of Europe. In fighting this war, called the First Balkan War, Bulgaria hoped to regain the territory it lost under the Treaty of Berlin. The Ottoman Empire was easily defeated. However, the victorious countries argued over the division of the lands they had won. In 1913, Bulgaria began the Second Balkan War by attacking Serbia and Greece. It was quickly defeated, and it lost much of the land it had gained during the First Balkan War. See **Bal-**

kans (The First Balkan War; The Second Balkan War).

The world wars. Bulgaria entered World War I (1914-1918) on the side of Germany and the other Central Powers in hope of regaining the territory it lost following the Second Balkan War. The Central Powers were defeated, and Bulgaria lost even more territory. After the war, Bulgaria was torn by political unrest and terrorism as various groups struggled for power.

Bulgaria's determination to regain its lost territory led it to enter World War II (1939-1945) as an ally of Germany and Italy. During the war, the country was heavily bombed. The Soviet Union invaded Bulgaria on Sept. 8, 1944. (The Soviet Union had been formed in 1922 under Russia's leadership, and it existed until 1991.) The day after the Soviet invasion, the Fatherland Front, a group of Bulgarian political organizations led by the Communist Party, overthrew the Bulgarian government.

Communist rule. The Communists did not completely control Bulgaria's new government, and so they immediately took steps to strengthen their power. They removed non-Communists from the government. People considered to be enemies were killed or sent to labor camps or prisons. Private property was seized, and freedom of the press was restricted. In 1946, the monarchy was abolished. Georgi Dimitrov, the chief Communist leader, became head of government. In 1947, Bulgaria adopted a Constitution modeled on that of the Soviet Union. By 1948, the Communists had total control of the country. Dimitrov died in 1949. In 1950, Vulko Chervenkov came to power. Industrialization increased under his rule, but the country's living standards declined.

In 1954, Todor Zhivkov became party head. In 1962, he also became head of state. In the early 1960's, the country still suffered from a severe shortage of basic goods and services. In addition, some members of the government began to resent Soviet influence in Bulgaria. In 1965, Zhivkov survived an attempted military take-over of his government. For the next 20 years, Zhivkov based his rule on sharing power between national and local government authorities, improving living standards, and maintaining close ties with the Soviet Union. He continued policies that restricted the freedom of Bulgarians.

Political changes. In the late 1980's, governmental reforms led to more freedom for people in the Soviet Union and other Communist countries of Eastern Europe. Influenced by these changes, people in Bulgaria held demonstrations against Zhivkov's government to demand democracy and greater freedom. A revolt within the Communist Party led by Foreign Minister Petar Mladenov and supported by the Soviet Union forced Zhivkov to leave office in November 1989. Zhivkov was arrested and, in 1992, was convicted of misusing government money. Mladenov was named to fill Zhivkov's posts of Communist Party chief and head of state. The new government increased the freedom of Bulgarians.

In January 1990, the Communist Party gave up its monopoly of power and allowed for a multiparty political system. In April, the party changed its name to the Bulgarian Socialist Party. Also in April, the National Assembly elected Mladenov to the new post of president, which became the country's most powerful position.

In June 1990, Bulgaria held its first free, multiparty elections in 44 years. The Bulgarian Socialist Party won the majority of seats in a new legislature called the Grand National Assembly. The Union of Democratic Forces (UDF) won the second highest number of seats. In July, protesters claimed that Mladenov had ordered military tanks to put down an antigovernment demonstration the previous December. He then resigned as president. In August, the Grand National Assembly elected Zhelyu Zhelev of the UDF as president. He became Bulgaria's first non-Communist head of state since 1944.

After a new Constitution was adopted in July 1991, the Grand National Assembly was renamed the National Assembly. The Constitution made the prime minister the most powerful government official. New legislative elections were held in October 1991, and a party that had split from the UDF—which was disbanded—won the most seats. This party later also took the name Union of Democratic Forces. Filip Dimitrov, the head of the new UDF, became prime minister. In January 1992, Zhelev was elected president by the people.

Recent developments. In legislative elections in 1994, a coalition led by the Bulgarian Socialist Party won a majority of seats. Zhan Videnov became prime minister. In 1996, Petar Stoyanov of the UDF was elected president. In legislative elections held in 1997, the UDF won the most seats, and Ivan Kostov became prime minister.

In 2001, the National Movement for Simeon II, a party led by Bulgaria's former king, won control of the National Assembly. Simeon's popularity helped bring the party to power even though he did not run for office. He later accepted the role of prime minister. Simeon had lived in exile during the country's Communist era. Later in 2001, voters elected Georgi Parvanov of the Bulgarian Socialist Party as president.

Sharon L. Wolchik

Related articles in *World Book* include:

Attar
Balkans
Danube River
Macedonia (historical region)
Plovdiv
Slavs
Sofia
Thrace
Warsaw Pact

Outline

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Questions

What is Bulgaria's chief farm product?
From what peoples are the Bulgarians descended?
Why did Bulgaria enter World Wars I and II?
What is Bulgaria's only important inland waterway?
What was the role of Simeon I in Bulgaria's history?
Where is Bulgaria's most fertile farmland?
Why did many rural Bulgarians move to cities after 1946?
What are Bulgaria's four main land regions?
Why did Bulgaria fight in the First Balkan War?

Bulge, Battle of the. See **World War II** (The drive to the Rhine).

Bulimia, *byoo LIHM ee uh,* is a disorder in which individuals experience frequent and uncontrollable periods of overeating called *binges.* Unlike other people who overeat, people with bulimia usually cannot stop a binge once it has started. They eat until they are too full to eat any more. After binging, most bulimics *purge* (eliminate) the food by making themselves vomit or by taking large doses of laxatives to help empty the bowels. Thus, most bulimics do not gain weight.

Many more women than men suffer from bulimia. The disorder occurs primarily among women from 13 to 40 years of age. It is estimated that several million American women suffer from bulimia at some time in their lives. Many cases of bulimia disappear after a few weeks or months, but may recur. Other cases last for years without interruption. Health risks associated with bulimia include damage to teeth and gums from the acid in vomit, persistent sore throat, and dehydration.

Bulimia has long been regarded as a psychologically based disorder caused by childhood experiences, family influences, and social pressures. As yet, little scientific evidence supports this widespread theory. However, group therapy, a technique of treating psychological disorders, has reportedly helped many bulimics stop their binge eating. Research suggests that bulimia may be partially caused by a chemical imbalance in the brain. In various studies, treatment with antidepressant drugs has helped many bulimic patients gain partial or full relief from their symptoms. Harrison G. Pope, Jr.

See also **Adolescent** (Eating disorders); **Anorexia nervosa.**

Bull. See **Cattle; Animal** (table: Names of animals); **Bears and bulls; Bullfighting; Taurus.**

Bull, in the Roman Catholic Church, is a decree or mandate issued by the pope on important or solemn occasions. The term comes from the Latin word *bulla,* which means *seal.* For centuries, lead seals were placed on papal bulls. Since 1878, most bulls have been stamped with a wax seal. Copies of a bull are sent to Catholic churches throughout the world, while the original is kept in Rome. A bull differs from an *encyclical,* which is a letter the pope addresses to the church and people of good will on important questions. Richard L. Schebera

Bull, John. See **John Bull.**

Bull Moose Party. See **Progressive Party.**

Bull Run, Battles of. See **Civil War.**

Bull terrier is a medium-sized dog that originally was bred in England from the bulldog and the old white English terrier. The bull terrier has the thick body and good nature of the bulldog, and the intelligence and quickness of the terrier. It weighs from 40 to 60 pounds (18 to 27 kilograms). It has a long, egg-shaped head; small, bright eyes; and small, pointed ears. The dog's straight tail is thick at the base and tapers to a point. Its coat is short and smooth. There are two varieties of bull terrier. One is all white, and the other is brindle with white markings. The bull terrier was used in England for dog *baiting* (fighting) and for catching rats. Today, the dog is prized as a pet and for its strength.

Critically reviewed by the Bull Terrier Club of America

See also **Dog** (picture: Terriers); **Miniature bull terrier.**

Bullbat. See **Nighthawk.**

Bulldog is a medium-sized dog with a thick, heavy, low-slung body. It has a large head, a short face, wide shoulders, and sturdy legs. The bulldog weighs from 40 to 50 pounds (18 to 23 kilograms). It may be red or brindle, white, fawn, or mottled. It is related to the ancient mastiff-like breeds. In England, the bulldog was used to bait bulls and bears from the 1200's until the sport was outlawed in 1835. Today, the bulldog ranks among the most even-tempered breeds and makes an excellent pet. Critically reviewed by the Bulldog Club of America

See also **Boxer; Bullmastiff; Dog** (picture: Nonsporting dogs); **French bulldog.**

Bulldozer is an earth-moving machine. It consists of a large, steel blade attached to the front of a tractor. The term is also used to mean the blade alone. The blade is mounted on a tractor that has either rubber tires or endless tracks like those of a battle tank. The driver can raise or lower the blade with a power control. Bulldozers are major tools in grading and excavating land for construction projects of all sizes, including earth dams, highways, railroads, and airports. J. P. Hartman

Bullet is a pointed cylinder of lead or other metal which is fired from a pistol, a revolver, a rifle, or a machine gun. Bullets are measured by their *caliber,* which is their diameter in one-hundredths of an inch, or in centimeters or millimeters. A .20-caliber bullet would be $\frac{20}{100}$ inch (5.08 millimeters) in diameter. Bullets vary between .22 and .60 in caliber.

Ball bullets are the type of bullets used in most army guns and hunting rifles. *Tracer bullets* contain a substance which leaves a trail of fire along the path of the bullet. *Armor-piercing bullets* have steel centers and blunt noses. These bullets are used against tanks and other armored targets.

Many bullets are made of lead which is hardened with small amounts of antimony. Bullets which are fired at high speed have lead centers covered with *jackets* or harder metal such as cupronickel. Jackets are made of steel and gilding metal, or of gilding metal only. Gilding metal is an alloy of copper and nickel.

Dumdum bullets have their jackets stripped back from the point to uncover the lead core. This makes them more harmful because the soft lead point spreads when it strikes. Such bullets are used in hunting large animals. International law forbids their military use.

The *velocity* (speed) of rifle bullets varies between 600 and 5,000 feet (180 and 1,500 meters) per second. Some bullets can hit targets as far away as 6,000 yards (5,500 meters). Frances M. Lussier

See also **Ammunition; Cartridge; Handgun; Machine gun; Rifle.**

Bullfighting is a contest between a bull and an individual called a *matador.* Bullfighting is popular in many Spanish-speaking countries, in Portugal, and in southern France. In such countries as Spain and Mexico, matadors are national heroes.

A bullfight takes place in a special stadium called a *plaza de toros* (bullring). During the bullfight, the matador faces the bull alone, attempting to maneuver the charging animal by waving a cape or a piece of cloth. In most countries, the matador kills the bull at the end of the bullfight. In Portugal and in some bullrings in France, it is illegal to kill the bull. Bulls used in a bull-

Lynn Sherwood

The paseo is the parade of matadors and their assistants into the ring before the bullfight. Matadors wear the *suit of lights*, the traditional costume decorated with gold thread and sequins.

fight are specially bred to attack. They are powerful, ferocious animals that may weigh 1,000 pounds (450 kilograms) or more. A bull can seriously gore or even kill a matador with its horns. In spite of its popularity, some people oppose bullfighting. They especially object to what they consider to be cruel treatment of the bulls and the pain and suffering inflicted on them.

Modern bullfighting dates from the 1700's when the first permanent bullring was built in Spain. The major breeds of fighting bulls were also developed in Spain during the 1700's. A number of matadors gained fame during the 1900's. The best known included Juan Belmonte, El Cordobés, Luis Dominguín, and Manolete, all of Spain, and Carlos Arruza of Mexico.

The bullring is shaped like a bowl. The bullfight takes place in the center, and the spectators are seated in a circle above. Most arenas are about 55 yards (50 meters) in diameter. The surface consists of firmly packed sand. The bull enters the arena from an entrance called the *toril*. A wooden fence about 5 feet (1.7 meters) high called the *barrera* separates the ring from the spectator area. Other facilities at the bullring include corrals for the bulls, an infirmary to treat injured matadors, and a chapel where the matador prays before the bullfight.

Spain alone has more than 400 bullrings. They seat from about 1,500 to more than 20,000 spectators. The Plaza de Toros Monumental in Mexico City is the world's largest bullring, seating about 55,000 people.

Types of bullfights. A bullfight is called a *corrida* in Spanish. Of the many types of bullfights, probably the two most common are the *corrida de toros* and the *novillada*.

The corrida de toros is the highest form of bullfight. Only *matadors de toros* participate. A matador de toros has received his title in a ceremony called the *alternativa*. Only matadors with experience, skill, and popularity are given the alternativa. A matador de toros is entitled to wear the *traje de luces* (suit of lights), the colorful traditional bullfighting uniform.

The novillada is a bullfight for less skilled matadors, called *novilleros*. In both the corrida de toros and the novillada, three matadors each fight two bulls, one at a time. The remainder of this article discusses a typical corrida de toros.

The order of the bullfight. A minute or two before the scheduled start of the bullfight, the *presidente* and his advisers enter their special box. The presidente is usually a local government official. He presides over the bullfight and gives permission for the corrida to progress from one stage to the next.

The corrida begins when a trumpeter blows a fanfare. Men on horseback called *alguaciles* ride across the ring to the presidente's box and tip their plumed hats to get the key to the toril. Next comes the *paseo*, the parade of matadors and their assistants into the ring.

After the paseo, the bullfight itself begins. The trum-

J. Ehlers, Bruce Coleman Inc.

The picador performs on horseback. He carries a lance called a *vara* that he forces into the bull's neck to weaken the animal's neck muscles.

Joe Craighead, Click/Chicago

A banderillero is one of the matador's assistants. Two banderilleros take turns placing three pairs of *banderillas* behind the bull's neck. A banderilla is a stick with a steel barb at one end. It is decorated with colored paper.

Fred Ward, Black Star

During the faena, the matador makes a number of passes at the bull with a *muleta*—a red cloth draped over a stick.

pet sounds and the toril is opened to allow the bull to enter the ring. Three of the matador's assistants, called *banderilleros,* take turns getting the bull to charge by waving a *capote.* The capote is a cape that is magenta on one side and yellow on the other. Bulls are color-blind. They react to the movement of the capote. The matador studies the bull, noting the quality of its eyesight and whether it charges straight or favors one horn. The matador then enters the ring and makes five or six passes with the capote, guiding the bull close to his body.

After the passes, the trumpet sounds and two *picadors* enter on horseback. Each picador carries a lance called a *vara.* The horses are blindfolded and protected by padding. The picador forces the vara into the bull's neck to weaken the muscles. This action is also called a *vara.* After each vara, a matador performs several passes with his capote. These passes are called the *quite.*

After two or three varas, the trumpet again sounds. The picador leaves the ring and the banderilleros enter. Two of them take turns placing three pairs of *banderillas* behind the bull's neck. A banderilla is a wooden stick about 28 inches (71 centimeters) long. It is decorated with colored paper and has a sharp barbed steel point.

The trumpet signals the last part of the fight, the *faena.* The matador enters the ring carrying a sword and a *muleta*—a red cloth draped over a stick. The matador makes a number of passes with the muleta. A performance is rated largely on the matador's grace and the amount of danger to which he exposes himself. Finally, the matador kills the bull with the sword, sliding it between the animal's shoulder blades. About 20 minutes elapse between the entry of the bull into the ring and its death.

If the matador has performed well, the crowd will applaud and cheer *ole!* The presidente may award the matador one of the bull's ears. If the performance is considered exceptional, the matador may receive two ears or even the ears and the tail. Barnaby Conrad III

See also **Mexico** (picture); **Portugal** (picture).

Additional resources

Conrad, Barnaby. *Encyclopedia of Bullfighting.* Houghton, 1961.
Schoenfeld, Bruce. *The Last Serious Thing: A Season at the Bullfights.* Simon & Schuster, 1992.

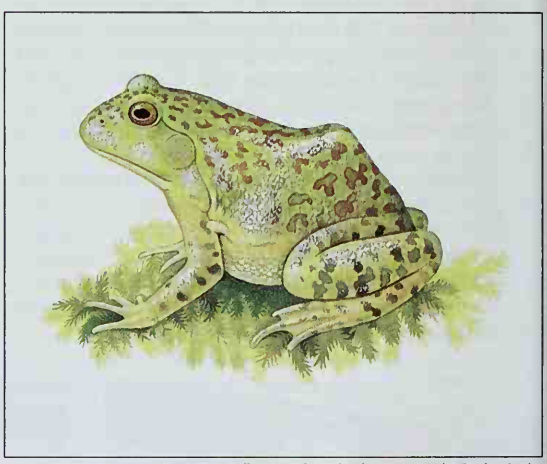
Bullfinch is a small European and Asiatic bird that can be taught to sing melodies. Its short, thick, bulging bill makes it look a little like a bull. It is slightly larger than a house sparrow. The male has a blue-gray back, rosy-red breast, and a black beak, crown, wings, and tail. The bullfinch feeds mostly on berries, seeds, and the buds of fruit trees. Sandra L. Vehrencamp

Scientific classification. The bullfinch belongs to the family Fringillidae. It is *Pyrrhula pyrrhula.*

Bullfrog is the largest frog of the United States. It is found in most parts of North America east of the Rocky Mountains and in many parts of the west.

Bullfrogs grow about 8 inches (20 centimeters) long, not including their hind legs, which may grow 10 inches (25 centimeters) long. Most bullfrogs have a yellowish-green or olive-green back and a white belly with brown markings. Some have yellow markings on the back. Males have a call that sounds like "jug-o-rum." They are heard, mostly at night, during the spring and summer. Female bullfrogs do not call. Bullfrogs spend most of their lives in or near ponds and slow streams. They seldom travel long distances on land.

The female bullfrog may lay up to 20,000 black-and-white eggs, usually near the surface of the water. The eggs hatch in 5 to 20 days and become *polliwogs* or *tadpoles.* In the northern states, the tadpoles grow to a length of up to 6 inches (15 centimeters) in two years.



WORLD BOOK illustration by Richard Lewington, The Garden Studio

The bullfrog is the largest frog in the United States. Many of them are caught for food because of their meaty legs.

They then gradually lose their long tails and turn into frogs only about 2 inches (5 centimeters) long. Bullfrogs eat insects and other small animals they can swallow. Tadpoles feed on small water plants.

Small bullfrogs are used as bait for fishing. Bullfrogs are caught for food because of their meaty legs and for dissection in biology classes. But in many states, bullfrogs are protected by law, especially in the breeding season. Don C. Forester

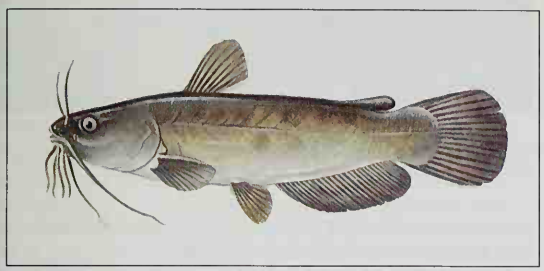
Scientific classification. The bullfrog belongs to the true frog family, Ranidae. It is *Rana catesbeiana.*

See also **Frog** (with picture); **Tadpole.**

Bullhead is the name given to six species of North American freshwater catfishes. Bullheads are also

known as *horned pouts* because they have eight hornlike growths, called *barbels,* near their mouths. Like all catfishes, bullheads do not have scales.

Bullheads are important game fish. They are found near the bottoms of quiet ponds and lakes, and slow-moving streams and rivers. They can live in waters that have low amounts of oxygen, where other species of fish might not be able to survive. Bullheads spawn in the spring and summer, laying their eggs in nests dug in the mud or in roots or plants. Young bullheads swim in dense schools.



WORLD BOOK illustration by Colin Newman, Linden Artists Ltd.

The yellow bullhead, like other bullheads, has several long hornlike growths near its mouth. Bullheads are kinds of catfish.

The *brown bullhead,* the *black bullhead,* and the *yellow bullhead* are the best-known species. The brown bullhead is usually yellowish-brown, olive, or bluish-black with spots along its sides. It grows to about 21 inches (53 centimeters) long and has dark barbels. The black bullhead is similar to the brown bullhead but smaller and without spots. It measures about 15 inches (38 centimeters) long. The yellow bullhead is usually olive or brownish above and yellow underneath. It grows about 15 inches long and has yellow or white barbels. The brown bullhead and the yellow bullhead are native to the eastern half of the United States and southern Canada. The black bullhead is native to waters from southern Ontario and the Great Lakes to the Gulf of Mexico. All three species have been introduced into many other areas. David W. Greenfield

Scientific classification. Bullheads belong to the bullhead catfish family, Ictaluridae. The scientific name for the brown bullhead is *Ictalurus nebulosus;* the black bullhead, *I. melas;* and the yellow bullhead, *I. natalis.*

See also Catfish.

Bullmastiff is a dog bred by crossing the bulldog and the mastiff. It was developed in the 1800's on the great estates of England, which wanted a dog smaller and more agile than the mastiff that would remain quiet until the gamekeeper needed it. The result was a fearless dog that made an excellent guard against poachers. Bullmastiffs stand about 24 to 27 inches (61 to 69 centimeters) high, and weigh 100 to 130 pounds (45 to 59 kilograms). The dog's short, dense coat may be colored fawn or brindle. Critically reviewed by the American Bullmastiff Association

Bulrush is the name given to several plants of the sedge family. They all grow in marshes or in shallow water. They have tough stems which are round or triangular and up to 12 feet (3.7 meters) tall. Their tiny flowers are clustered into small brownish spikelets at or near the tops of the stems. Mats may be woven from the stems. They also furnish raw materials for thatch, boats, and houses. The seed is an important food for wild ducks. See also Cattail; Papyrus; Rush; Sedge.

David A. Francko

Scientific classification. Bulrushes are in the sedge family, Cyperaceae. They are members of the genus *Scirpus.*

Bulwer, Sir Henry. See Clayton-Bulwer Treaty.

Bulwer-Lytton, Edward George Earle Lytton (1803-1873), was an English author. He is now known mainly for his carefully constructed and documented historical novels. His most famous novel is *The Last Days of Pompeii* (1834), a story set in the Roman city just before it was buried by an eruption from Mount Vesuvius. The book contrasts the luxury and brutality of paganism with the simple virtues of primitive Christianity.

In his own day, Bulwer was known for the variety of his works. *Pelham* (1828), perhaps his best novel, is partly an early example of detective fiction. *Paul Clifford* (1830) attacks capital punishment. In *The Caxtons* (1849), Bulwer told a simple tale of family life, while *The Coming Race* (1871) describes a Utopian civilization found deep in the earth (see Utopia).

Bulwer wrote three successful plays that are among the few Victorian dramas of interest today. They are *The Lady of Lyons* (1838), *Richelieu* (1839), and *Money* (1840). The role of Cardinal Richelieu is one of the most theatrically effective in English drama. *Money* is a serious comedy that anticipates the social dramas of later English playwrights such as John Galsworthy.

Bulwer was born in London. He served as a member of Parliament and was secretary for the British colonies between 1858 and 1859. He was made Baron Lytton in 1866. K. K. Collins

Bumble bee is a large, burly bee that often has mostly black and yellow coloring. Bumble bees may be seen flying among flower blossoms during spring, summer, and fall. They live in most countries, from the Arctic to the Antarctic. Australia and some Pacific islands had no bumble bees until people brought them there.

Fine, thick hairs cover bumble bees' bodies. Like other bees, bumble bees have membranous wings. Queen bumble bees range from $\frac{3}{5}$ to 1 inch (16 to 25 millimeters) long. Workers and *drones* (males) are smaller.

WORLD BOOK photo by E. F. Hoppe

The bullmastiff was bred to guard English estates.

Many people fear bumble bees because of their noisy buzzing flight and long, sharp stings. Unlike honey bees, bumble bees do not die when they sting. They can sting repeatedly, but only do so when defending their nest or when handled.

Life of the bumble bee. Bumble bees are *social insects.* This means that they live in *colonies* (groups). The organization of the colony is not as complex as that of a honey bee colony. Only the queen bumble bee lives through the winter and starts a colony in the spring. During the summer, the colony may increase in size to 50 to several hundred bees. Many bumble bees make nests in thick tufts of grass or in shallow holes in the ground. Occasionally a young queen may use an abandoned mouse nest for the colony's home, while some species may nest in tree holes or in old birds' nests.

In early spring, the young queen bumble bee crawls out of the crack in the ground in which she spent the winter. She flies about and searches for a place to start a new colony. She frequently drops to the ground and runs about looking for a good spot. Once she has picked her nesting place, the queen rarely leaves it, except to obtain nectar and honey from nearby flowers.

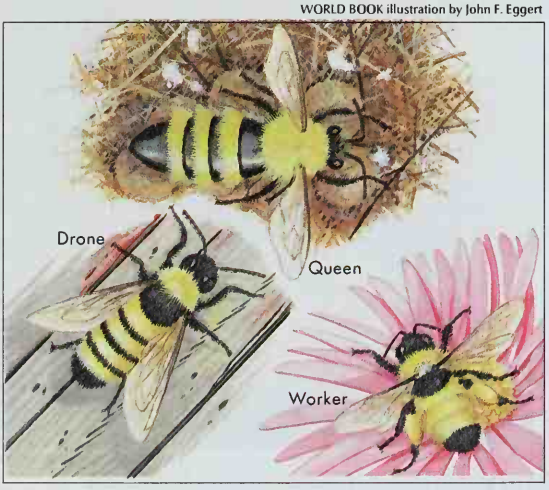
In the nest, the queen produces wax from her abdomen and builds a honey pot. She places nectar in this pot to eat during cold weather. Next, she builds a wax egg cell and lays eggs in it. In three or four days, they hatch into wormlike *larvae.* The queen feeds these larvae a mixture of pollen and nectar. In about a week, the larvae spin cocoons and change into *pupae* (see **Pupa**).

The young bumble bees emerge from their cocoons in about 22 days. These first offspring are all *workers.* Two or three days after they emerge, the workers leave to hunt for nectar and pollen. They bring the food back to the nest for the colony to use. Some workers build more wax cells and enlarge the nest. The queen lays more eggs. Workers feed and take care of the new larvae. The queen's only duty now is to lay eggs.

Late in the summer, the colony rears drones and queens. The drones do no work. Their only use to the colony is to mate with young queens. The young queens soon leave the nest, mate, and find places in the ground where they spend the winter. The old queen bumble bee and the workers die before winter.

Some kinds of bumble bees

WORLD BOOK illustration by John F. Eggert



Edward S. Ross

The bumble bee lives in a nest. The female lays eggs in wax cells. The eggs hatch into larvae, which develop into pupae.

Importance of bumble bees. Sometimes a field of clover or vetch has so many bumble bees that they outnumber the honey bees. Bumble bees are among the farmer's best friends. They *pollinate* (help fertilize) numerous wild plants and many plants important as food for livestock. In gathering nectar and pollen, the bumble bees carry pollen from one flower to another. They have long tongues with which they can reach nectar deep within the flowers of red clover, vetch, and honeysuckle.

Enemies of bumble bees include certain beetles, flies, ants, mites, and wasps. Birds and skunks may eat the adult bees and the larvae and pupae from nests that are not well hidden. But humans probably rank as the worst enemy. Farmers use insecticides that kill bees along with insect pests. In addition, they destroy bumble bee nests in cultivating land. Bernd Heinrich

Scientific classification. Bumble bees are members of the order Hymenoptera. They belong to the family Apidae, subfamily Bombinae.

See also **Bee; Clover; Hibernation.**

Bunchberry, also called *dwarf cornel,* is a small plant in the dogwood family. Bunchberry plants have slender stems that grow 4 to 8 inches (10 to 20 centimeters) tall. Four to six leaves grow in a circle near the top of the stem. In the early summer, a cluster of small greenish-white flowers develops on a short stalk above the leaves. Four white specialized leaves, called *bracts,* surround the flower cluster. People often mistake the bracts for flower petals. By late summer, the flowers develop into bright red fruits. The fruits are edible and some people like them in puddings.

Bunchberries grow in moist woods and bogs from Greenland to Alaska and eastern Asia, and from New Jersey to Minnesota. They also grow in the Appalachian Mountains south to Virginia, and in the Pacific Coast States. Jerry M. Baskin

Scientific classification. Bunchberry belongs to the dogwood family, Cornaceae. Its scientific name is *Cornus canadensis.*

See also **Flower** (picture: Flowers of woodlands and forests).

Bunche, Ralph Johnson (1904-1971), was an American statesman. In 1950, he won the Nobel Peace Prize, the first awarded to a black. He was appointed to the United Nations Palestine Commission in 1947, and

worked with Count Folke Bernadotte on the Arab-Israeli dispute. After Bernadotte was assassinated, Bunche took on a leading role in the negotiations and arranged an armistice in 1949. Bunche won the peace prize for this work.

Bunche was considered an authority on problems of colonialism. He began his diplomatic career in 1944 when he joined the Department of State. Bunche served as adviser or delegate to nine international conferences in four years. He helped lay the groundwork for the United Nations (UN). and, in 1946, became director of the division of trusteeships in the Secretariat. He was an undersecretary of the UN from 1955 to 1971.

Bunche was born in Detroit. He worked his way through the University of California at Los Angeles and graduated in 1927. He received a Ph.D. from Harvard University in 1934. Bunche also studied in London and South Africa. He began teaching at Howard University in 1928. Bunche won the Spingarn Medal in 1949 (see **Spingarn Medal**). Alton Hornsby, Jr.

Additional resources

Rivlin, Benjamin, ed. *Ralph Bunche.* Holmes & Meier, 1990.
Urquhart, Brian. *Ralph Bunche: An American Life.* Norton, 1993.

Bunin, *BOO nyihn,* **Ivan,** *ih VAHN* (1870-1953), was the first Russian to receive the Nobel Prize for literature. He won the award in 1933. Bunin began his career as a poet and translator of verse, but became famous for his short stories and novels. "The Gentleman from San Francisco" (1915) is his best-known story. The novel *The Village* (1909-1910), Bunin's first international success, is a grim tale about the misery of Russian village life during the early 1900's. *The Well of Days* (1930) is a fictionalized autobiography.

Ivan Alexeyevich Bunin was born in Voronezh. He immigrated to France in 1919 and lived there for the rest of his life. Anna Lisa Crone

See also **Russian literature** (Symbolism).

Bunion, *BUHN yuhn,* is a hard swelling on the foot at the place where the great toe connects with the rest of the foot. The tissues over the swollen area become thick and red. A bunion may be painful and disabling, and may make it difficult to fit shoes. Bunions can be an inherited characteristic, and they can also be caused by improperly fitting shoes. They may be relieved by larger shoes or by surgery. John F. Waller

Bunker Hill, Battle of, was the bloodiest battle of the Revolutionary War in America (1775-1783). More than 1,000 British soldiers and about 400 American patriots were killed or wounded.

The battle occurred in June 1775. During that month, thousands of colonists besieged the British Army in Boston. British Lieutenant General Thomas Gage planned to fortify the hills on Dorchester Heights, south of Boston. The American patriots learned of the plan and decided to occupy Bunker Hill, which was on Charlestown Peninsula, across the Charles River north of Boston. On the night of June 16, patriot troops moved onto the peninsula from the northwest. They bypassed Bunker Hill and fortified Breed's Hill, which was closer to Boston. Reserve troops occupied Bunker Hill.

Early the next morning, the British realized what had happened and began to ferry 2,500 troops under Major General William Howe across the Charles. The American troops, commanded by Colonel William Prescott, faced them from behind a fortified line on top of Breed's Hill. The British attacked twice but retreated in the face of patriot fire. The British charged a third time. By this time, the Americans were running out of powder and could not get any more from supporting troops on Bunker Hill. The Americans then retreated from the Charlestown Peninsula. James Kirby Martin

Additional resources

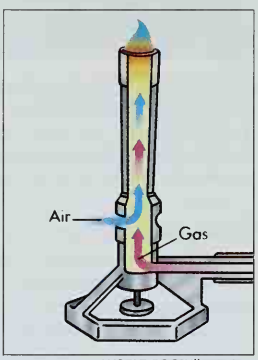
Elting, John R. *The Battle of Bunker's Hill.* Freneau, 1975.
Ketchum, Richard M. *Decisive Day: The Battle for Bunker Hill.* 2nd ed. 1974. Reprint. Henry Holt, 1999.
Kirby, Philippa. *Glorious Days, Dreadful Days: The Battle of Bunker Hill.* Raintree Steck-Vaughn, 1993. Younger readers.

Bunsen, Robert Wilhelm (1811-1899), was a German chemist. He became famous for his work with the German physicist Gustav Kirchhoff in using the spectrometer to identify chemical elements (see **Spectrometer**). In the 1850's, he invented a gas burner, still known as the *Bunsen burner,* which provides an intensely hot flame for laboratory use. He also invented several types of electric cells and apparatus used in experiments on the properties of gases. He contributed to the early development of organic chemistry.

Bunsen was born in Göttingen, Germany. He studied at the universities of Göttingen, Paris, Berlin, and Vienna. He was professor of chemistry at the University of Heidelberg and became famous as a great teacher.

Seymour Harold Mauskopf

Bunsen burner is a gas burner used for heating substances in scientific laboratories. It consists of a metal tube on a stand and a long rubber hose that connects the tube to a gas jet. Several adjustable openings at the bottom of the tube control the amount of air that enters and mixes with the gas. The temperature of the flame is regulated by increasing or decreasing the amount of air in the tube. Because the gas mixes with air before burning, it produces a flame that is smokeless. Harriet V. Taylor



WORLD BOOK illustration by Sarah Woodward
The Bunsen burner

See also **Bunsen, Robert Wilhelm.**

Bunshaft, Gordon (1909-1990), an American architect, greatly influenced the style of corporate architecture in the mid-1900's. In 1937, Bunshaft began work as an architect for Louis Skidmore of the firm of Skidmore and Owings. In 1939, he joined the firm of Skidmore, Owings, and Merrill as a designer. During his long career with the firm, Bunshaft designed some of the most important commercial skyscrapers of his time.

Bunshaft's most significant buildings include Lever House (1952), Manufacturers Hanover Trust (1954), and Chase Manhattan Bank (1961), all in New York City. The structures reflect Bunshaft's conviction that architecture should be functional art. For example, Lever House is a skyscraper on stilts. The elevated horizontal base covers its site to provide a civic plaza. The shaft, set back and

Ezra Stoller © ESTO

Gordon Bunshaft's Lever House in New York City is one of the most important skyscrapers of the mid-1900's. The 24-story office building is noted for its blue-green glass curtain walls on a stainless-steel frame. The structure, completed in 1952, is supported on slender columns and encloses a public garden court.

balanced on the base, soars in precisely proportioned vertical and horizontal ribbons of steel and glass. Bunshaft was born in Buffalo, New York. Dennis Domer

Bunting is a name that is loosely used for various seed-eating birds. Buntings live in a wide variety of climates worldwide. Some of these birds are brightly colored. But not all buntings are closely related. The best-known North American species is the *indigo bunting.*

The *painted bunting* of the southeastern United States is about 6 inches (15 centimeters) long. The male has a purplish-blue head, green back, red rump and underparts, and dark wings and tail. The female painted bunting is green above and yellow below. The *lazuli bunting* lives in the western United States and Canada. The male's head, throat, and back are bright turquoise-blue. Its underside is white, and its breast and sides are cinnamon-brown. The lark bunting is commonly found in the Prairie States and northern Canadian provinces. The male is black and has white wing patches.

Fred J. Alsop, III

Scientific classification. Buntings belong to the family Emberizidae. The painted bunting is *Passerina ciris.* The lazuli bunting is *P. amoena.* The lark bunting is *Calamospiza melanocorys.*

See also Bird (table: State and provincial birds; pictures: Birds of grasslands; Birds of brushy areas); **Indigo bunting.**

Buñuel, *boon yoo EHL,* **Luis** (1900-1983), was a Spanish-born film director and writer. He became famous for his realistic and often cynical films about modern society. His film *The Young and the Damned* (1951) is a grim study of juvenile delinquency in Mexico. *Viridiana* (1961) attacks religious hypocrisy. *The Discreet Charm of the Bourgeoisie,* a satire on upper-class life, won the 1972 Academy Award as best foreign-language film.

Buñuel was born in Calanda, near Teruel. His first successes were *An Andalusian Dog* (1929) and *The Golden Age* (1930), two surrealistic films made with painter Salvador Dali in France. Both films caused controversy because of their grotesque and often sexual images. Buñuel moved to the United States in 1938, but made no films until he moved to Mexico in 1947. His other films include the documentary *Land Without Bread* (1932), *Nazarin* (1958), *Belle de Jour* (1966), and *Tristana* (1970). Buñuel also wrote an autobiography, *My Last Sigh* (1983). A collection of his writings was published as *An Unspeakable Betrayal* in 2000, after his death.

Gene D. Phillips

Bunyan, John (1628-1688), an English preacher, wrote *The Pilgrim's Progress* (1678, 1684). This book has been translated into over 100 languages and read throughout the world. It is a religious allegory, in which people and places represent vices and virtues. Christian, the hero, sets out from the City of Destruction to go to the Celestial City (heaven). On the way, he meets some people who try to harm him, such as Apollyon, and Giant Despair. Others, such as Interpreter and Faithful, help him. After many adventures, Christian finally crosses a river and reaches the Celestial City. See **Allegory.**

Most readers of *The Pilgrim's Progress* think it is a religious message. It is also a good story. Bunyan's style is vivid and racy. It is based on the Bible and on the common speech of Bedfordshire, his home. Bunyan's other main works are *Grace Abounding* (1666), *The Life and Death of Mr. Badman* (1680), and *The Holy War* (1682).

Bunyan was born near Bedford, England. Like his father, he was a *tinker* (maker and mender of utensils). Bunyan received little education. He served as a soldier from 1644 to 1646. He was married in 1648 or 1649. His wife led him to think seriously of religion. He became convinced that he had led a bad life, and he joined a nonconformist church in Bedford. Soon he began to preach there. Bunyan was arrested for preaching without a license and was jailed in 1660. He spent most of the next 12 years in jail. He wrote many religious works in jail. He was released in 1672, became pastor of his church, and was returned to jail in 1675. Here he began to write *The Pilgrim's Progress.* Many schools used it as a text during the 1700's. Steven N. Zwicker

Additional resources

Mullett, Michael A. *John Bunyan in Context.* Duquesne Univ. Pr., 1997.

Sadler, Lynn V. *John Bunyan.* Twayne, 1979.

Bunyan, Paul, is a giant lumberjack in American folklore. He became famous for his great strength and incredible logging feats. Bunyan ranks among the greatest legendary frontier heroes who helped settle and develop the United States. He has become a fixture of modern urban folklore, reflecting what urban residents think lumberjacks admired and told of in their legends.

According to legend, Paul Bunyan created much of America and invented logging in the Pacific Northwest. He dug Puget Sound in Washington to float huge logs to the mill. He cleared trees from North and South Dakota and made the land in those states suitable for farming. He also scooped out the Great Lakes to provide drinking water for his giant blue ox, Babe.

Many stories about Paul Bunyan center on Babe. The ox ate great amounts of hay and potato peels and could haul a whole forest of logs. When Babe needed new shoes, Big Ole the blacksmith had to open a new iron mine in Minnesota. The shoes were so heavy that Big Ole sank knee-deep into solid rock while carrying them.

No one knows how the legend of Paul Bunyan began. Some historians think it developed from old French folk tales about giants. French-Canadian lumberjacks may have passed on these tales in the New World. But the popular image of Bunyan was created largely by advertising, the press, and books for children. The first written reference to Bunyan appeared in stories by James McGillivray, an American journalist, in a Detroit newspaper in 1910. McGillivray based his stories on tales he had heard from Michigan lumberjacks. In 1914, an American lumber company began to issue promotional booklets with stories and cartoons about Bunyan.

During the 1920's, Paul Bunyan tales became a popular feature in many newspapers. Two books, one by Esther Shephard in 1924 and the other by James Stevens in 1925, helped spread the legend. Since then, Bunyan stories have been featured in ballets, dramas, operas, and especially children's books. Ellen J. Stekert

Additional resources

Emberley, Barbara. *The Story of Paul Bunyan.* Simon & Schuster, 1994. Younger readers.

Rogers, D. Laurence. *Paul Bunyan: How a Terrible Timber Feller Became a Legend.* Hist. Pr., 1993.

Wood, Audrey. *The Bunyans.* Blue Sky Pr., 1996. The story of Paul Bunyan and his family. Younger readers.

Buonarroti, Michelangelo. See Michelangelo.

Buoy, *boy* or *BOO ee,* is a floating object which is anchored in the water to guide ships. Buoys help ship captains and pilots to steer safely in harbors, rivers, and other bodies of water. All ships carry charts showing where buoys are located, and what kind they are.

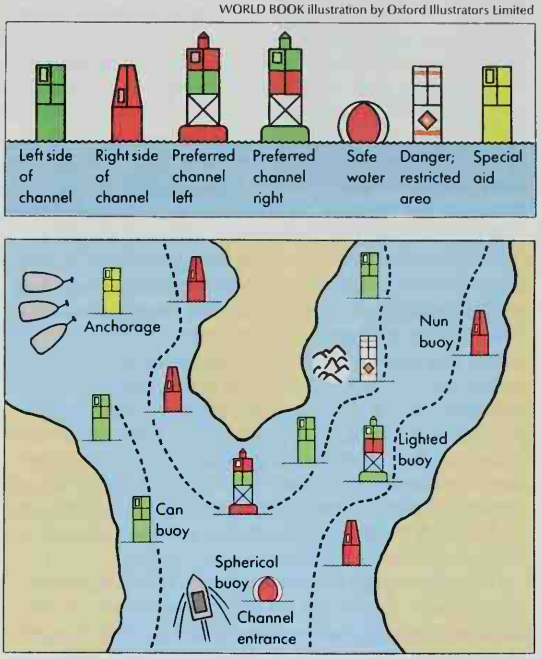
Different kinds of buoys are used for different purposes. In United States harbors, red buoys mark the right side of a channel for a ship entering a harbor. Green buoys mark the left side. Red and white buoys mark safe water. Buoys with an orange diamond on white are information markers or regulatory markers. They may be used to show a danger spot or a restricted area. Yellow buoys mean that special information can be found on charts or learned from other sources. In some other countries, green buoys mark the right side and red buoys mark the left side of a returning water route.

Buoys also differ in shape. *Can buoys* are metal cans shaped like cylinders with flat tops. Metal *nun buoys* are shaped like cones. Green buoys are can buoys. Red buoys are nun buoys. Both can and nun buoys sometimes have horizontal bands of green and red to show the preferred channel. Green over red means that the preferred channel is on the right. Red over green indicates that it is on the left. Red and white buoys are spheres or have a spherical red mark on top. They are usually located at a channel entrance. Buoys are usually numbered. Green buoys are given odd numbers, and red buoys receive even numbers.

Types of buoys

Buoys help ships steer safely through harbors, rivers, and other bodies of water. Different kinds of buoys have different purposes, which are indicated by their color or markings.

WORLD BOOK illustration by Oxford Illustrators Limited



Other buoys have lights so that they can be seen at night. The color of their lights and the length of their flashes tell the pilot what their signals mean. Another type of buoy gives its signal with a whistle, gong, or bell. The advantage of sounding buoys is that their signals can be heard when it is too foggy to see the lighted buoys. Robert L. Scheina

See also **Boating** (with picture); **Navigation.**

Bur grass. See Sandbur.

Burbank, California (pop. 100,316), is a residential, commercial, and industrial city in the northern Los Angeles metropolitan area. The city lies in the San Fernando Valley. For location, see **California** (political map). Burbank's chief industry is entertainment. The National Broadcasting Company (NBC) produces television programs in the city, and Warner Brothers and other motion-picture companies make films at the Burbank Studios. The headquarters of Walt Disney Productions are in the city. The city of Burbank was incorporated in 1911. It has a council-manager form of government. Kenneth Reich

Burbank, Luther (1849-1926), was an American plant breeder, nurseryman, and horticulturist. He introduced and developed many new fruits, vegetables, flowers, and grasses. His most famous creations include the *Burbank potato,* the *Santa Rosa plum,* and the *Shasta daisy.*

His life. Burbank was born in Lancaster, Massachusetts. He had little opportunity for formal education but did attend Lancaster Academy, a college preparatory

school, for a short time. He left school after his father died. He supported his mother by raising and selling vegetables.

Burbank read many works on botany by the British naturalist Charles R. Darwin and was influenced by Darwin's views on the evolution of plants. Burbank took a special interest in *hybrids*—that is, plants produced from breeding two kinds of plants. In his early 20's, Burbank harvested a rare seed pod of *Early Rose potato*. He planted 23 of its seeds, and they produced two promising seedlings. Burbank sold the best seedling for $150 to a nurseryman, who called it *Burbank's Seedling*. This event started Burbank on his career in plant breeding.

Burbank moved to California in 1875 and started a nursery business in Santa Rosa two years later. In 1885, he purchased a farm in nearby Sebastopol to carry out plant-breeding activities. He struck a financial bonanza with his importation of *Japanese plums* in 1885. These plums and some of Burbank's other imports were well suited to California's climate and proved especially valuable as breeding stock. In 1912, Burbank sold his past, present, and future creations to a firm that became known as the Luther Burbank Company. The company went bankrupt in less than four years and Burbank's reputation suffered. After the company declared bankruptcy, Burbank started over again and established a successful seed business.

His achievements and methods. Burbank experimented with almost 200 *genera* (groups) of plants. He became a popular national figure and did much to popularize plant breeding. A number of his creations were produced from complex *cross-pollinations* (transfers of pollens) involving many species. Burbank introduced more than 250 *cultivars* (varieties) of fruit, including 113 kinds of plums. Many of his vegetables were cultivated widely during his life. Today, the most commonly grown variety of potato in the United States is the *Russett Burbank*, a strain of the Burbank potato. Burbank's most important ornamental plant, the Shasta daisy, was created from crossings involving four chrysanthemum species.

Burbank cannot be considered a scientist in the academic sense. He left few records, and his crossings were frequently made with mixed pollens rather than pure pollens. However, Burbank instinctively understood correct plant-breeding procedures. He made extensive crossings, grew thousands of seedlings, and continued to intercross the best seedlings to produce the most desirable hybrids. Although Burbank had no direct impact on genetics or plant breeding, his accomplishments were examples of evolution in action. Jules Janick

Additional resources

Dreyer, Peter. *A Gardener Touched with Genius: The Life of Luther Burbank.* Rev. ed. Univ. of Calif. Pr., 1985.

Quackenbush, Robert M. *Here a Plant, There a Plant, Everywhere a Plant, Plant! A Story of Luther Burbank.* Rev. ed. Luther Burbank Home & Gardens, 1995. Younger readers.

Whitson, John, and others, eds. *Luther Burbank.* 12 vols. Luther Burbank Pr., 1914-1915.

Burchfield, Charles Ephraim (1893-1967), was an American water-color painter of landscapes and rural life. His earliest works deal with childhood fantasies and scenes from nature. He later turned to more realistic studies of industrial subjects and the gloomy aspects of small-town life. These scenes were based on his early years spent in Salem, Ohio, and on his adult years in Buffalo, New York. Some of Burchfield's paintings of decaying Victorian houses are at times humorous, and at other times full of mystery. Burchfield was born in Ashtabula, Ohio. Sarah Burns

Burdock is the name of several species of coarse, hairy weeds. Burdocks are also called *beggar's-buttons* and *clotburs*. They have large, heart-shaped leaves. The roots live for two seasons. The stalks grow from 4 to 9 feet (1.2 to 2.7 meters) high during the second season. Burdocks are troublesome in the United States and Canada. Their seed heads stick to the hair of cattle and

Water color (1930) by Charles E. Burchfield, Fine Arts Gallery of San Diego

Burchfield's *Rainy Night* shows how the artist captured a feeling of dreariness in small-town life in the United States.

sheep. Burdocks can be destroyed by cutting off the flowers before seeds form.

Scientific classification. Burdocks make up the genus *Arctium* in the composite family, Asteraceae or Compositae.

Harold D. Coble

© Giuseppe Mazza

Burdock blossoms

Bureau of . . . See articles on bureaus listed under their key word, as in **Indian Affairs, Bureau of.**

Bureaucracy, *byu RAHK ruh see,* is a system that carries out the functions of a government or a private organization. The authority to perform many routine duties is divided among departments called bureaus. In most large bureaucracies, power is controlled by a number of officials instead of by one leader. However, a single leader may be held responsible for the actions of many minor officials and employees. The term comes from the French word *bureau,* meaning *office.*

Bureaucracies occur most frequently in large, complex organizations that require many employees to provide a variety of specialized services. The federal government is the largest bureaucracy in the United States. It employs several million civilian men and women. Individual government agencies regulate activities in such fields as banking, business, farming, and social security.

Bureaucracies also may function in churches, corporations, schools, and other organizations. Max Weber, a German sociologist of the early 1900's, considered bureaucracy the most important feature of modern society. He stated that all bureaucracies have common characteristics. For example, each has a leader who delegates authority to other officials, forming a chain of command. All bureaucracies also work in limited areas of jurisdiction and follow systematic, written procedures.

All modern industrial nations rely on bureaucracy. At best, a bureaucracy uses sound management techniques to improve efficiency. But people who deal with a large agency often feel frustrated by bureaucratic *red tape* (see **Red tape**). Critics also argue that such a complex system fails to define the responsibilities of each department. This situation can result in wasted resources and a duplication of effort. Peter Woll

See also **Parkinson's Law; Weber, Max.**

Burger, Warren Earl (1907-1995), served as chief justice of the United States from 1969 to 1986. President Richard M. Nixon nominated him to succeed Chief Justice Earl Warren, who retired. Burger helped reverse the liberal direction that the court had taken under Warren.

In his early years as chief justice, Burger joined several decisions that continued the Warren Court's trend. In 1971, for example, he wrote a unanimous decision allowing school busing to end "all vestiges of state-imposed segregation." But the court's makeup changed in the 1970's and early 1980's, as conservatives were appointed to replace more liberal judges who had died or retired. As a result, the Burger Court limited or overturned many important decisions of the Warren Court.

The Burger Court modified the obligation of school boards to desegregate and removed long-standing restrictions on police and prosecuting attorneys. The Burger Court also allowed local governments to become more fully involved in supporting religious activities. In addition, it upheld the use of capital punishment. Burger often called for reforms to reduce the workload of courts, especially that of the Supreme Court. He also favored decreasing the powers of federal courts and increasing those of state courts.

Supreme Court Historical Society

Warren E. Burger

Burger was born in St. Paul, Minnesota. He graduated from St. Paul College of Law (now Mitchell College of Law) in 1931. He was a faculty member at Mitchell from 1933 to 1953 and practiced law from 1931 to 1953. Burger was an assistant U.S. attorney general from 1953 to 1956. He then served as a judge of the U.S. Court of Appeals for the District of Columbia until he became chief justice. Owen M. Fiss

Burgess, *BUR jihs,* **Anthony** (1917-1993), was an English novelist and critic. Many of his novels reflect his interest in languages and their evolution. The characters of Burgess' best-known novel, *A Clockwork Orange* (1962), speak a language that he invented. It consists of English, Russian, and slang of both languages. The novel tells about young men who react violently against a dehumanized society of the near future.

Burgess wrote novels on political satire, spies, history, religion, and the love life of the English playwright William Shakespeare. Burgess' three related novels—*Inside Mr. Enderby* (1963), *Enderby Outside* (1968), and *A Clockwork Testament* (1974)—portray a poet torn between the demands of the everyday world and the need to express his own creativity. His other novels include *Honey for the Bears* (1963), *Napoleon Symphony* (1974), and *Earthly Powers* (1980).

Burgess' literary criticism includes *The Novel Now* (1967); *Urgent Copy* (1969); and *Joysprick* (1973), a study of the language of Irish author James Joyce. Burgess also composed music, translated plays, and wrote dramas and short stories. John Anthony Burgess Wilson was born in Manchester. Michael Seidel

Burgess, *BUR jihs,* **Thornton Waldo** (1874-1965), was an American author of children's books about animals and wildlife. Burgess felt it was important to represent his fictional characters accurately as animals. He is best known as the author of many stories about Peter Rabbit. Burgess began writing them as bedtime stories for his son, using the character created by English children's author Beatrix Potter.

Burgess wrote over 70 books and many stories for newspaper publication. Most of his books were written as series, such as the *Mother West Wind* books (1910-1918). *Now I Remember: Autobiography of an Amateur Naturalist* (1960) is his autobiography. He was born in Sandwich, Massachusetts. Kathryn Pierson Jennings

Burgesses, House of. See **House of Burgesses.**

Burghley, *BUR lee,* **Lord** (1520-1598), also spelled *Burleigh,* was an English statesman. Burghley directed

England's foreign and domestic affairs during the reign of Elizabeth I, often called England's *Golden Age*.

Burghley served King Edward VI as secretary of state from 1550 to 1553. When Elizabeth became queen in 1558, she made Burghley her chief adviser. "No Prince in Europe hath such a councillor as I have in him," she said. Together, Elizabeth and Burghley ruled England for 40 years (see **England** [The reign of Elizabeth I]).

Burghley was born William Cecil in Bourne, near Grantham, England, and attended Cambridge University. His son Thomas became Earl of Exeter, and his son Robert became Earl of Salisbury. Lacey Baldwin Smith

Burglar alarm is an electronic device that helps protect people and their property. It is designed to detect an intruder's entry or attempted entry into the area being protected and to notify proper authorities that an intruder has been detected. Controls allow the owner of a device to turn it on or off.

Most burglar alarms have three parts—a *sensor,* a *control unit,* and either an *annunciation device* or a *communication device.* The sensor detects an intruder and sends a signal to the control unit. A sensor may be wired directly to the unit, or it may use a wireless transmitting device. The control unit is the system's main component. It is connected to switches or a keypad used for operating the system. When the control unit receives a signal from a sensor, it triggers an annunciation device or a communication device. Annunciation devices include bells, sirens, or flashing lights intended to frighten away intruders. Communication devices transmit a signal to either a *monitoring center* or a police department. Most alarms are transmitted to a monitoring center, which often calls the property owner first to verify a real emergency. The monitoring center will then notify police if necessary. A monitoring center also may be able to arm or disarm a system from a remote location.

There are several kinds of burglar alarms, based chiefly on sensor type. Switches called *contacts* are a kind of sensor installed at doors and windows. When a door or window is opened, the contacts trigger an alarm. Other sensors detect the breaking of glass.

Some alarms include motion sensors. One type of motion sensor sends *microwaves* (short radio waves) into an area. Any movement in that area disturbs the wave pattern and sets off the alarm. Microwaves can protect a wide area because they travel through walls and furniture. Other motion sensors send out *ultrasonic* (high-pitched sound) waves, which work similarly to microwaves but are blocked by walls and furniture. Some alarms use *infrared* (invisible light) sensors that detect temperature changes caused by an intruder. Another type of sensor is an *electric eye* (see **Electric eye**). Such devices use infrared beams. When an intruder interrupts the beams, an alarm is triggered.

Critically reviewed by National Burglar & Fire Alarm Association, Inc.

Burglary is a crime that is defined differently by the laws of various states in the United States. Usually a crime is defined as a burglary when a person enters another person's house or place of business without permission, with the intention of committing a crime.

Many people confuse burglary with the crime of *robbery,* but the two are quite different. A criminal commits a robbery by taking something from a person by force or by threats of violence. A criminal commits a burglary by entering a house or building illegally, even though the criminal makes no contact with any person inside. Thus, a criminal *robs* a person, but *burglarizes* a house.

Burglary is a *felony* (serious crime) usually punishable by imprisonment for up to 20 years. Charles F. Wellford

See also **Burglar alarm; Felony; Larceny; Robbery.**

Burgoyne, *buhr GOYN,* **John** (1722-1792), was a British general of the Revolutionary War in America (1775-1783). In 1777, he submitted a plan to the British government for invading New York state from Canada and meeting other British troops in the state. He argued that such an invasion would end American resistance to British forces by cutting off New England from the other colonies. Burgoyne was given command of an army.

Burgoyne advanced his troops to near Albany, N.Y. There he lost almost 1,000 men in a battle near Benning-

Surrender of General Burgoyne at Saratoga (1786), an oil painting on canvas by John Trumbull; Yale University Art Gallery

General John Burgoyne surrendered his troops to American General Horatio Gates at Saratoga, N.Y., in 1777. In this painting, the defeated Burgoyne offers his sword to Gates. Burgoyne's surrender was a turning point in the Revolutionary War.

ton, Vermont. Soon he was surrounded by a much larger American army under General Horatio Gates. Burgoyne surrendered at Saratoga, New York, on Oct. 17, 1777. This battle helped bring France into the war as an ally of the United States and has been called one of the most decisive battles of history. Burgoyne was born in Bedfordshire. He became a major general in 1772 and lieutenant general in August 1777. John L. Bullion

Burgundy is a historic region in east-central France. It has a population of about 1,600,000 and covers 12,194 square miles (31,582 square kilometers). For the location of Burgundy, see France (terrain map).

Grape growing is a leading occupation. For centuries, Burgundy wines have been world famous. The region also produces excellent beef, chickens, butter, cheese, fish, and snails. Many manufacturing plants operate in the region. The town of Le Creusot produces steel. Dijon, the largest city, has a variety of industries.

Burgundy has been a kingdom, a duchy, a county, and a province of France. The name *Burgundy* originated in the 400's, when the Burgundians moved into Gaul from Germany. They established a kingdom that covered most of present-day southeastern France. The Peace of Verdun in 843 divided the Burgundian territories. The eastern half became known as the County of Burgundy, then as Franche-Comté, or Free County. The western half became the Duchy of Burgundy and a part of France. During the reign of Louis XIV, in the 1600's, the county and the duchy united to form the province of Burgundy. It was a province until 1789, the first year of the French Revolution. It now consists of the *departments* (administrative districts) of Côte-d'Or, Nièvre, Saône-et-Loire, and Yonne. Hugh D. Clout

See also Wine (Where wine comes from).

Burial. See Funeral customs.

Burke, Edmund (1729-1797), a British statesman, influenced the history of Britain and many other countries. He served as a Whig member of Parliament from 1765 until 1794 and frequently spoke his mind on major issues. Burke was a productive author and a powerful orator. Besides essays on politics, he wrote a book on aesthetics, *A Philosophical Enquiry into the Origin of Our Ideas of the Sublime and the Beautiful* (1757).

During the American Revolutionary period, he repeatedly urged the British government to conciliate the colonies. He believed that the colonists should be allowed to enjoy all the rights of British citizens.

Burke was born in Dublin, Ireland. He worked for betterment of English-Irish relations and Irish conditions, and opposed the slave trade. He achieved fame in his attempt to improve British administration in India (see Hastings, Warren).

Although he had worked to limit the power of British royalty, Burke bitterly criticized the French Revolution (1789-1799). He denounced its injustice to individuals, attacks on religion, and attempts to build a completely new social order. He expressed hostility in parliamentary speeches and writings, chiefly in *Reflections on the Revolution in France* (1790), which greatly influenced British policy and opinion. His ideas became the philosophy of the Conservative Party. James J. Sack

Burke, John (1859-1937), served from 1913 to 1921 as treasurer of the United States under President Woodrow Wilson. A Democrat, he also served three terms as governor of North Dakota from 1907 to 1912. Burke served as a state senator from 1893 to 1895, and as a North Dakota Supreme Court justice from 1925 to 1937. He was born in Keokuk County, Iowa. A statue of Burke represents North Dakota in Statuary Hall in the U.S. Capitol in Washington, D.C. John M. Mulder

Burke, Martha Jane. See Calamity Jane.

Burke's Peerage is a book that contains the names of all the peers and baronets of the United Kingdom and of some Irish peers. The full title is *Genealogical and Heraldic Dictionary of the Peerage and Baronetage of the United Kingdom.* This book is considered the best source of information about the ancestry of the families of the United Kingdom. Burke's *Peerage* is published every year. In 1826, John Burke, an Irishman, published the first edition. Robert E. Dowse

Burkina Faso, *bur KEE nuh FAH soh,* is a country in western Africa. It lies about 600 miles (970 kilometers) east of the Atlantic Ocean in the western "bulge" of Africa. The country was formerly called Upper Volta. In 1984, its name was changed to Burkina Faso. *Burkina* is a name for the country's people. It means *honest people. Burkina Faso* means *land of the honest people.*

Landlocked Burkina Faso is one of Africa's poorest and least developed countries. It consists mostly of wooded, grassy plains atop a plateau. The dry, rocky landscape turns green for only a few months each year. Because the country lacks rich soil and mineral deposits, many of its people have only the bare necessities of life. Most people are black Africans who make their living by farming and raising cattle. France governed Burkina Faso for 63 years before it became independent in 1960. Ouagadougou is the capital and largest city.

WORLD BOOK maps

Government. A president heads the government. The president is elected by the people to a seven-year term and can be reelected only once. A Council of Ministers helps the president carry out day-to-day operations of the government. The Assembly of People's Deputies makes the country's laws. The people elect the 107 members of the Assembly to five-year terms.

Burkina Faso is divided into 30 provinces for purposes of local government. A high commissioner leads the government of each province.

People. Most of the people of Burkina Faso belong to one of two main cultural groups, the Voltaic and the Mande. The Voltaic group includes the Mossi, the Bobo, the Gurunsi, and the Lobi peoples. The Mossi make up about half of the country's population. For over 800 years, they have had a kingdom with a central government headed by the *Moro Naba* (Mossi chief). A Moro Naba still holds court in Ouagadougou, the principal Mossi city. Most of the Mossi are farmers who live in the central and eastern parts of Burkina Faso. The typical Mossi family lives in a *yiri*, a group of mud-brick houses surrounding a small court. The families keep sheep and goats in the court.

The Bobo, the Gurunsi, and the Lobi each make up less than 10 percent of the population. The Bobo live in the southwest around Bobo Dioulasso. They live in large villages where they build castlelike houses with clay brick walls and straw roofs. The Gurunsi, who live around Koudougou, have adopted modern changes more readily than the Mossi have. The Lobi live in the Gaoua region. They have long been good hunters and farmers, but now they work as migrant laborers in and around the cities.

The Mande group includes the Boussance, Marka, Samo, and Senufo peoples. These peoples are branches of Mande groups living in neighboring Mali, Guinea, and northern Côte d'Ivoire. Burkina Faso also has several hundred thousand Fulani and Tuareg nomads. These people travel between grazing areas in the northern part of Burkina Faso with their goats, sheep, and other livestock. A few Hausa merchants live in urban areas.

Halperin, Monkmeyer

At an outdoor market in Ouagadougou, the capital of Burkina Faso, people buy food and other goods. The Mossi women shown here are wearing traditional clothing and carrying their goods on top of their heads.

Facts in brief

Capital: Ouagadougou.
Official language: French.
Area: 105,792 mi² (274,000 km²). *Greatest distances*— east-west, 525 mi (845 km); north-south, 400 mi (644 km).
Elevation: *Highest*—Aiguille de Sindou, 2,352 ft (717 m) above sea level, in the southwest. *Lowest*—about 650 ft (198 m) above sea level.
Population: *Estimated 2002 population*—12,600,000; density, 119 per mi² (46 per km²); distribution, 85 percent rural, 15 percent urban. *1985 census*— 7,964,705.
Chief products: *Agriculture*—corn, cotton, fonio, livestock, millet, shea nuts, rice.
National anthem: "L' Hymne de la Victoire" ("The Anthem of Victory").
Flag: Two equal horizontal stripes of red and green. A yellow star lies in the center. Adopted in 1984. See **Flag** (picture: Flags of Africa).
Money: *Basic unit*—franc.

Most of the people of Burkina Faso practice local traditional religions. About 30 percent of the people are Muslims, and less than 10 percent are Christians.

Most of Burkina Faso's adult population cannot read and write, and only about a third of its children attend school. For the country's literacy rate, see **Literacy** (table: Literacy rates). The University of Ouagadougou is the nation's only university.

Land. Burkina Faso is a vast inland plateau that varies from 650 to 2,300 feet (198 to 701 meters) or more above sea level. Wooded grassland covers most of the country, but there is a swampy region in the southeast and wooded hills lie in the west.

Rivers have cut many valleys in the plateau. The Black Volta, Red Volta, and White Volta rivers flow south to Ghana's Lake Volta. Small rivers in the east flow into the Niger River. But most of Burkina Faso is dry and rocky. The country's poor, thin soil does not hold water. The 30 to 45 inches (76 to 114 centimeters) of rain that most of Burkina Faso gets each year quickly runs off.

Burkina Faso's climate is cool and dry from November to February, and hot and dry from March to April. From May to October, it is wet and hot. The average temperatures for most of the year in Burkina Faso range from 68 to 95 °F (20 to 35 °C).

Economy. Cattle raising is the most important activity in Burkina Faso's economy. The country has between 2 million and 3 million each of cattle, goats, and sheep. Livestock exports make up from a third to a half of the export income.

Most farmland in the country is in river valleys. Farmers use almost all of it to raise such food crops as beans, corn, millet, rice, sorghum, and *fonio*. Fonio is a crab grass with seeds that are used as a cereal. The main cash crops are cotton, peanuts, and *shea nuts* (seeds that contain a fat used to make soap).

Burkina Faso exports livestock to Côte d'Ivoire and Ghana, and cotton and shea nuts to France. It imports food and agricultural equipment from France and other members of the European Union. Many of Burkina Faso's young men go to Ghana and Côte d'Ivoire to work for two or three years on cocoa and coffee plantations and as laborers in the cities. The money they send

home is an important part of Burkina Faso's income.

A railroad connects Ouagadougou with Abidjan, Côte d'Ivoire. Ouagadougou and Bobo Dioulasso have airports.

History. The Mossi have the longest history of any people in Burkina Faso. The Mossi of the Yatenga region, northwest of Ouagadougou, set up a well-organized kingdom in the 1300's. They moved their capital to Ouagadougou in the mid-1400's. They had a strong military force and fought off powerful Songhai invaders from what is now Mali in the 1500's. But the attacks weakened the Mossi kingdom and it began to decline.

Most Europeans did not learn of the Mossi kingdom until the 1800's. France captured Ouagadougou in September 1896. In January 1897, the Moro Naba signed a treaty placing the Mossi kingdom under French protection. In 1919, France created the colony of Upper Volta in what is now Burkina Faso, then dismantled it in 1932 and divided it among three other French colonies—Côte d'Ivoire, French Sudan (now Mali), and Niger. France recreated Upper Volta with its pre-1932 boundaries in 1947.

Upper Volta's independence movement began later than similar movements in neighboring French colonies. Many political parties were formed to represent the Mossi, Bobo, and other peoples. The African Democratic Rally Party, led by Ouezzin Coulibaly, became the largest.

In 1957, Coulibaly became head of Upper Volta's government. Upper Volta became a self-governing state within the French Community in 1958. Coulibaly died in 1958, and Maurice Yaméogo took his place. In 1959, Upper Volta joined Dahomey (now Benin), Côte d'Ivoire, and Niger in the Council of the Entente, a group formed to solve the region's economic and social problems.

On Aug. 5, 1960, Upper Volta became an independent republic with Yaméogo as president and head of the African Democratic Rally Party, soon the country's only legal political party. By January 1966, the people had become dissatisfied with Yaméogo's rule. A general strike by labor union workers protested wage reductions proposed by the government and governmental dishonesty. During the strike, the army took control of the government. General Sangoule Lamizana became head of the military government.

In 1970, voters approved a new Constitution and elected a legislature. Lamizana remained as president. In 1971, he appointed a civilian prime minister. But in 1974, Lamizana suspended the Constitution, abolished the office of prime minister, and dissolved the legislature. He then ruled with the assistance of a cabinet that included many military officers. A new Constitution, adopted in 1977, restored civilian rule. In 1978, Lamizana was elected president. In 1980, Colonel Saye Zerbo overthrew Lamizana in the first of a series of *coups d'états* (revolts against the government) in Burkina Faso. These coups eventually led to Captain Blaise Compaoré becoming president in 1987.

Burkina Faso adopted a new Constitution in June 1991, and a multiparty presidential election was held in December of that year. But opposition parties refused to participate in the election because they claimed election reform was needed first. Compaoré won by a huge margin. A few days after the election, Burkina Faso's most important opposition leader was assassinated.

Elections for a new legislative body, the Assembly of People's Deputies, were held in May 1992. Compaoré's party, the Organization for Popular Democracy-Labor Movement, won most of the seats. Mark W. DeLancey

See also **French West Africa; Ouagadougou.**

Burlap is a coarse, heavy cloth woven with yarns made from fibers of the jute plant. It is sometimes called *Hessian cloth.* Burlap has a light tan color. The cloth is made in different widths and weights. Its main use is for bags for agricultural and industrial products. Large quantities of the cloth are used as protective coverings in wrapping packages and as a supporting fabric in upholstered furniture. Wide-width burlap is used as carpet backing. See also **Jute.** Christine W. Jarvis

Burleigh, *BUR lee,* **Harry Thacker** (1866-1949), was an African American composer and singer. He did much to preserve and popularize black folk melodies and was one of the first people to sing black spirituals on the concert stage. Burleigh arranged more than 100 folk songs, including "Deep River" and "Nobody Knows the Trouble I've Seen." He was strongly influenced by the nationalism of the Czech composer Antonín Dvořák. Burleigh was born in Erie, Pennsylvania, and won the Spingarn Medal in 1917. Gerald Bordman

Burleigh, Lord. See **Burghley, Lord.**

Burlesque, *bur LEHSK,* was a popular form of variety entertainment in the United States during the early 1900's. Burlesque achieved its peak of popularity from 1905 to the 1920's. During this time, burlesque was presented in a standard format that resembled vaudeville (see **Vaudeville**). Comedians, variety acts, and skits alternated with musical numbers that featured beautiful women and bawdy humor.

The term *burlesque* comes from the Italian word *burla,* which means *jest* or *mockery.* American burlesque originated in the mid-1800's from many forms of entertainment, including the circus, minstrel shows, and broad comedies called *farces.* Until the 1920's burlesque shows attracted audiences of men and women. But by the late 1920's, sexual content became increasingly important and burlesque began to attract men only.

In the 1930's, Billy Minsky introduced striptease acts into burlesque shows he presented in New York City. Soon burlesque was featuring scantily dressed females instead of the traditional comedians and humor. By the mid-1900's, burlesque no longer existed as a distinct form of entertainment.

Burlesque is also a literary form. In literature, a burlesque is a story, poem, or play that ridicules a familiar subject or literary work through exaggeration or parody (see **Parody**). Don B. Wilmeth

Burlington (pop. 38,889; met. area pop. 169,391), is the largest city in Vermont and the home of the University of Vermont. It lies in the northwestern part of the state, on the east shore of Lake Champlain. For location, see **Vermont** (political map). Burlington is called the *Queen City of Vermont* because of its splendid setting near the Green Mountains. A 42-foot (13-meter) shaft in Greenmount Cemetery marks the grave of Ethan Allen, a Revolutionary War hero. Burlington is a retail and financial center. Its major manufacturer produces military equipment. The city has a mayor-council form of government. See also **Vermont** (picture). Sam Hemingway

Burma. See Myanmar.

Burma Road was built between 1937 and 1938 to carry war supplies to China for its war against Japan. The road served as a "back door" to China, and avoided Japan's blockade of the Chinese coast.

About 160,000 Chinese and Burmese laborers built the Burma Road under great hardship. The road had a base of large rocks, filled with crushed stone, and topped by mud. The road wound about 700 miles (1,100 kilometers) across mountains and through thick jungle from Lashio, Burma (now Myanmar), to Kunming, China.

Japanese troops captured the Burmese part of the road and closed it in 1942. In 1945, toward the end of World War II, Allied forces united the Burma Road with a new road, the Ledo Road, from Ledo, India. The combined route provided a supply route 1,079 miles (1,736 kilometers) long from India to China. It played an important part in the defeat of the Japanese. The road was later renamed the Stilwell Road after General Joseph Stilwell, who commanded U.S. forces in the China-Burma-India theater in World War II. Maurice Matloff

Burn ranks among the most serious and painful injuries. Most burns result from contact with burning materials, such as clothing. Burns can also be caused by electricity, chemicals, or hot liquids. Burns caused by hot liquids or hot steam are called *scalds*.

Burns can affect all of the body's systems. A serious burn destroys much of the skin, which in turn causes the body to lose fluid. Loss of body fluids can cause a life-threatening condition called *shock* (see **Shock**).

Classification of burns. Burns are typically classified as *first-degree, second-degree,* or *third-degree,* depending on the depth of the burn and the degree of tissue damage. A first-degree burn, such as mild sunburn, affects only the surface layers of the skin. The burned area is red and tender. A second-degree burn affects deeper layers, causing blisters to form. Swelling also may occur. Many second-degree burns are caused by deep sunburn, contact with hot liquids or hot objects, or brief exposure to flames.

A third-degree burn penetrates all of the layers of the skin and affects the tissues underneath. The skin may appear white, very red, or even charred. Most victims have no feeling in the area of a third-degree burn because the burn destroys nerve endings.

First-aid care is vital for a victim of almost any burn. Call for emergency medical help immediately if the burn affects breathing, involves the face or more than one part of the body, or produces blisters. Any large burn may cause shock. To reduce the effects of shock, the victim should rest in a horizontal position and be kept warm with a blanket.

Burns should be cooled immediately by flushing the burned area with cool water or by applying cool, wet towels until the pain subsides or professional help arrives. Cooling the area immediately can help prevent the burn from worsening. Burns can be loosely wrapped in a sterile bandage to help prevent infection and reduce pain until professional medical help is obtained.

Chemical burns should be flushed immediately with water for at least 20 minutes or until emergency medical assistance arrives. Have the victim remove any clothing or items such as glasses, goggles, or jewelry that have come in contact with the chemicals.

Electrical burns can cause tissue damage that is more often internal than external. Such burns can result in respiratory or heart failure. An ambulance should be called immediately for any victim of an electrical burn.

Advanced medical care for burns includes restoring the body's normal balance of fluids. Physicians fight infection by applying special compounds to burns that also promote healing. Most large third-degree burns do not heal naturally. They are treated by removing the destroyed skin and replacing it with *skin grafts* (see **Skin grafting**). Victims of severe burns receive physical therapy when muscles or other deep tissues are affected. Therapy also includes activities designed to ensure the victim's emotional well-being.

Critically reviewed by the American Red Cross

See also **First aid; Sunburn.**

Burne-Jones, Sir Edward (1833-1898), was a British painter whose precisely executed Romantic style made him one of the foremost artists of his day. Many of his works portray Greek myths and the legends of King Arthur. He was a member of the art movement called the Pre-Raphaelite Brotherhood. Burne-Jones was born in Birmingham, England. He studied to become a minister but gave up a church career to become a painter. He also designed stained glass and tapestries and illustrated books. See also **Knights and knighthood** (illustration: Legends about knights); **Pre-Raphaelite Brotherhood.**

Burnell, Jocelyn Bell. See **Bell Burnell, Jocelyn.**

Burnet, Sir Macfarlane, *muk FAHR luhn* (1899-1985), an Australian physician and virologist, shared the 1960 Nobel Prize in physiology or medicine with British biologist Peter Brian Medawar. In 1949, Burnet and his colleague Frank Fenner proposed the theory of *acquired immunological tolerance*. They stated that an animal's immune system develops gradually during *fetal life* and if foreign tissues were introduced into the fetus early in its development, the fetus would accept the tissues as its own. Later, if tissues from the same foreign source were introduced into the adult animal, the immune system would not reject the tissues. Acquired immunological tolerance was later proved by Medawar and his colleagues.

Burnet also developed a method of cultivating viruses in chick embryos. For many years, this method was widely used by scientists to grow and study viruses. Burnet was born in Traralgon, Victoria. His full name was Frank Macfarlane Burnet. Dale C. Smith

Burnett, Frances Hodgson (1849-1924), was an English-born author best known for her children's novel *Little Lord Fauntleroy* (1886). The novel tells a "rags to riches" story about an American boy who is found by his rich English grandfather and placed in a position of wealth. Fauntleroy wears long curls and a velvet suit with lace cuffs and collar. The outfit became a popular fashion for boys in the late 1800's.

Frances Eliza Hodgson was born in Manchester, England. In 1865, she moved with her family to Knoxville, Tennessee. She married Swan Burnett, a Knoxville doctor, in 1873. Burnett wrote two other popular children's novels, *A Little Princess* (1905) and *The Secret Garden* (1911). Jill P. May

Burney, Fanny (1752-1840), was an English author. During her lifetime, Burney became famous as a successful novelist. Today, she is best known for her first

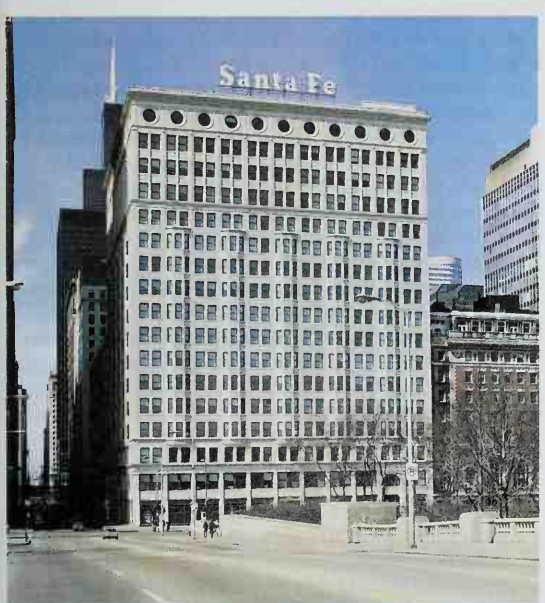
novel, *Evelina,* and for her diary.

Evelina, or a Young Lady's Entrance into the World, was published in 1778. It tells about a virtuous and intelligent, but inexperienced, country girl in London society. *Evelina* received high praise. As a result, Burney became acquainted with the great writer Samuel Johnson and with Sir Joshua Reynolds and other members of Johnson's literary circle. She later wrote *Cecilia, or Memoirs of an Heiress* (1782), which deals with a young woman's financial and marital problems.

Burney began a diary in 1768 and continued it for more than 70 years. Published after her death, it vividly describes English social life during her lifetime. It also provides valuable information about the many famous people whom Burney knew. Frances Burney was born in King's Lynn, England. Michael Seidel

Burnham, *BUR nuhm,* **Daniel Hudson** (1846-1912), was one of the chief members of the Chicago School of architecture. He felt that the architect's most important contribution lay in the broader area of city and regional planning. His reputation was established by urban plans for Chicago, Cleveland, Detroit, San Francisco, and Washington, D.C. Burnham believed that an architect needed a large, highly trained technical staff and an ability to work in the worlds of business and politics. His approach to the practice of architecture anticipated the way successful American architects organized their practices after 1900.

Burnham was born in Henderson, New York. He and John Root formed a partnership in Chicago in 1873. Their stark, simple Monadnock Building (1891) in Chicago is considered a forerunner of architecture of the 1900's. The firm's Reliance Building (1894) in Chicago, with its steel frame and terra-cotta covering, marked a notable advance in skyscraper design. After Root's death in 1891, Burnham designed the Flatiron Building (1902) in New York City and Union Station (1908) in Washington, D.C. Nicholas Adams



Cameramann International, Ltd.

Burnham's Railway Exchange Building, completed in Chicago in 1904, was one of the first U.S. skyscrapers.

See also **Architecture** (Early modern architecture in America); **Chicago** (A city reborn; picture: The Reliance Building); **City planning** (The Industrial Revolution); **Root, John Wellborn.**

Burns, Arthur Frank (1904-1987), an economist and educator, was chairman of the Board of Governors of the United States Federal Reserve System from 1970 to 1978. He served as U.S. ambassador to West Germany from 1981 to 1985.

Burns was born in Stanislau, Austria, and came to the United States with his parents when he was 10 years old. He earned undergraduate and graduate degrees at Columbia University. He was associated with the National Bureau of Economic Research from 1930 to 1969. Burns taught economics at Rutgers University from 1927 to 1944 and served as professor of economics at Columbia from 1944 to 1969.

Burns was chairman of the Council of Economic Advisers under President Dwight D. Eisenhower from 1953 to 1956. In 1969 and 1970, he served as counselor to the president—a post with Cabinet status—under Richard M. Nixon. Burns was coauthor of *Measuring Business Cycles* (1946), and he wrote other books on economics. Leonard S. Silk

Burns, George (1896-1996), had one of the longest careers in American show business history. By the time he died at the age of 100, Burns had become a national institution as a comedian and actor. He was especially appreciated for his dry wit, raspy singing voice, and ever-present cigar.

Burns was born in New York City. His real name was Nathan Birnbaum. In 1922, he met Gracie Allen and they soon formed one of the most beloved comedy teams of the 1900's. The couple married in 1926. The team of Burns and Allen starred in a popular radio show from 1932 to 1950, when they moved to television.

In 1929, Burns and Allen appeared in their first short movie comedy, *Lamb Chops.*

They made their feature-length film debut in the comedy *The Big Broadcast* (1932). He appeared with Gracie Allen in 13 more feature comedies of the 1930's.

Burns won an Academy Award as best supporting actor for his performance as a member of a once popular vaudeville team in *The Sunshine Boys* (1975). Burns also appeared in the movies *Oh God!* (1977), *Just You and Me Kid* (1979), *Going in Style* (1980), *Oh God! Book II* (1982), *Oh God! You Devil* (1984). Dan Zeff

Burns, Robert (1759-1796), is the national poet of Scotland. He wrote brilliant narrative poems, such as "Tam o' Shanter," and clever satires, including "The Holy Fair," "Address to the Deil," and "Holy Willie's Prayer." But Burns is probably best known for his songs, especially "Auld Lang Syne," "Comin Thro' the Rye," and "For a'that and a'that." Many of Burns's lines have become familiar quotations. These lines include "Oh wad some Pow'r the giftie gie us / To see oursels as others see us!" from "To a Louse"; and "The best laid schemes o' mice and men / Gang aft agley" from "To a Mouse." See **Auld Lang Syne.**

Burns's life. Burns was born in Alloway, a village on the River Doon. Like his father, Burns was a farmer, and he remained one almost all his life, despite his success as a writer. The farmer's hard way of life taught Burns to

take joy in fleeting pleasure and to be skeptical of the moral codes of the well-to-do. These attitudes, along with his capacity for love, friendship, and hearty tavern fellowship, provide the chief themes of his poetry. Burns had only a few years of formal education, but he read many books by English and Scottish authors. In his traditional "verse epistles," or "letters" from one poet to another, Burns summarized the simple rustic focus of his work: "Give me a spark o' Nature's fire!/That's a' the learning I desire."

In 1786, Burns decided to move to Jamaica because of setbacks in farming and an unhappy love affair with Jean Armour, a Scottish girl. But the success that year of his first volume of poems caused him to change his mind. He went, instead, to Edinburgh, where, for over a year, he was popular with fashionable society.

In 1788, Burns returned to farming. That year, he married Armour. They had nine children. Burns's literary success helped him get an appointment as *exciseman* (tax and customs official) in 1788. This position gave Burns a steady income for the rest of his life. In 1791, he gave up farming and moved to Dumfries. He died there at the age of 37. The heavy farm labor in Burns's youth had weakened his health and helped cause his early death.

Burns's works. Burns was interested in authentic folk songs. He collected about 300 original and traditional Scottish songs for books compiled in his day, including *The Scots Musical Museum* (1787). Burns wrote many poems to be sung to Scottish folk tunes. He adapted some of his best-loved songs, including "Comin Thro' the Rye," from bawdy lyrics. Others, such as "A Red, Red Rose," he pieced together almost entirely from songs composed by other writers. But even those works that Burns adapted from other sources have qualities uniquely his own.

Detail of oil portrait by Alexander Nasmyth; National Portrait Gallery, London

Robert Burns

Burns wrote in both the Scots dialect and standard English, using each to express different kinds of ideas. He wrote in English when he wanted to express customary or respectable ideas, as in "A Prayer in the Prospect of Death" and much of "To a Mountain Daisy." When Burns wished to express ideas that conflicted with custom or that dealt with less respectable aspects of human nature, he adopted the language of the uneducated Scottish peasant. Examples include "The Jolly Beggars" and "Address to the Unco Guid."

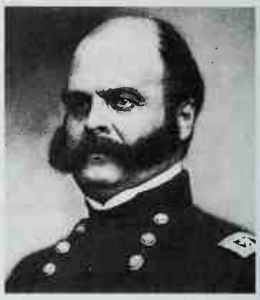
In his time, Burns was considered an unlearned plowman, but he was really a skilled poet. He could use not only a traditional Scottish stanza form, as in "To a Mouse," but also the sophisticated English Spenserian stanza, as in "The Cotter's Saturday Night." The dialect Burns used was a partly artificial language adapted from earlier Scottish writers, including Allan Ramsay and Robert Fergusson. Sometimes, Burns did not use true dialect, but respelled English words and phrases in Scots. He used much more art than people thought, but what we feel is not so much the art as the vigorous life of his poetry. Frederick W. Shilstone

Additional resources

Bold, Alan N. *A Burns Companion.* St. Martin's, 1991.
Findon, Joanne. *Auld Lang Syne.* Stoddart, 1998. A biography of Burns. Younger readers.
Mackay, James. *Burns.* Mainstream, 1992.
McIntyre, Ian. *Dirt and Deity: A Life of Robert Burns.* 1995. Reprint. HarperCollins, 1998.

Burnside, Ambrose Everett (1824-1881), was a Union general in the Civil War (1861-1865). His name has become a part of the language because he popularized a style of beard. His habit of allowing whiskers to grow on the sides of his face gave rise to the term *burnsides,* which later became *sideburns.*

When the Civil War broke out, Burnside became a colonel of a Rhode Island volunteer regiment. He commanded the brigade that opened the first Battle of Bull Run (also called Manassas). Later, Burnside led an expedition that seized points along the North Carolina coast. As a major general, Burnside commanded a corps in the Army of the Potomac at the Battle of Antietam. He later succeeded General George B. McClellan as commander of that army. He met defeat in Fredericksburg in 1862. Relieved of command, he served in Ohio and Tennessee. In 1864, Burnside became a corps commander in Virginia. But he was forced to resign in 1865 for poor performance during the Siege of Petersburg.



Brown Bros.

Ambrose Burnside

Burnside was born in Liberty, Indiana, and graduated from the U.S. Military Academy. In 1853, he began to manufacture a breech-loading rifle he had invented. After the war, he engaged in railroad activities. Burnside was governor of Rhode Island from 1866 to 1869, and a U.S. senator from 1875 to 1881. John F. Marszalek

Burpee, Lawrence Johnston (1873-1946), a Canadian historian, was largely responsible for establishing the Canadian Historical Association in 1922. He wrote *A Bibliography of Canadian Fiction* (1904), *A Little Book of Canadian Essays* (1909), and *Encyclopedia of Canadian History* (1926). He served as librarian of the Carnegie Public Library in Ottawa, and, in 1912, became secretary for Canada of the International Joint Commission. He was born in Halifax, Nova Scotia. David Jay Bercuson

Burr, Aaron (1756-1836), was vice president of the United States from 1801 to 1805, under President Thomas Jefferson. Burr's brilliant career and promising future declined disastrously after he killed Alexander Hamilton, Jefferson's most famous political opponent, in a gun duel in 1804. Burr's reputation was hurt further when he was charged with working to make part of the southwestern frontier an independent nation.

Early years. Burr was born in Newark, New Jersey. He graduated from the College of New Jersey (now Princeton University). He fought with the colonial army

in the Revolutionary War from 1775 to 1779, rising to lieutenant colonel. Burr distinguished himself at the Battle of Monmouth.

He became a lawyer in 1782 and practiced in Albany, New York, and New York City. Soon, he became a top U.S. lawyer. He served New York as a state legislator and as attorney general in 1789. He was elected to the U.S. Senate in 1791, defeating Alexander Hamilton's father-in-law, General Philip Schuyler.

Detail of oil portrait by John Vanderlyn, New-York Historical Society, New York City

Aaron Burr

Gains recognition. The Democratic-Republican Party chose Burr as Jefferson's vice presidential running mate in 1796 and in 1800. According to the voting procedures of the time, each Electoral College member voted for two people. The person with the most votes became president, and the person with the second most votes became vice president. Jefferson lost his bid for the presidency in 1796 but became vice president under President John Adams. In the 1800 election, Burr and Jefferson received the same number of electoral votes, tying for the presidency even though the electors who voted for them intended to elect Jefferson to the presidency and Burr to the vice presidency. The U.S. House of Representatives had to take 36 ballots to break the tie, finally electing Jefferson as president. Burr became vice president. Hamilton, who disliked Burr more than he did Jefferson, helped elect Jefferson.

Burr ran for governor of New York in 1804. Hamilton again opposed him. Burr lost the election. He then challenged Hamilton to a duel. On July 11, 1804, the men faced each other with pistols in Weehawken, New Jersey. Burr fatally wounded Hamilton. A New York coroner's inquest "found a verdict of wilful murder by Aaron Burr, vice president of the United States." A New Jersey grand jury indicted him for murder, but he was never arrested. Burr presided over the Senate until his term ended.

Tried for treason. After his vice presidency, Burr engaged in a complex web of questionable activities. He traveled through the American West and recruited men. The commander in New Orleans, General James Wilkinson, whose patriotism has also been questioned, arrested Burr. The question was whether Burr was assembling a group to invade Mexico, whether he was scheming to detach part of the southwestern frontier from the United States, or both.

Burr was tried for treason in 1807 and was *acquitted* (declared innocent) of the charges. Burr later went to Europe and tried to arouse support for his Mexican scheme. When he returned to the United States in 1812, he entered the country under an assumed name, Adolphus Arnot. He again prospered as a lawyer in New York City, using his own name. William W. Freehling

See also **Hamilton, Alexander; Jefferson, Thomas** (The Burr conspiracy).

Additional resources

Fleming, Thomas J. *Duel: Alexander Hamilton, Aaron Burr, and the Future of America.* Basic Bks., 1999.
Lomask, Milton. *Aaron Burr.* 2 vols. Farrar, 1979, 1982.
Melton, Buckner F., Jr. *Aaron Burr: Conspiracy to Treason.* Wiley, 2001.

Burro. See Donkey.

Burroughs, *BUR ohz,* **Edgar Rice** (1875-1950), an American author, created Tarzan, one of the most famous characters in fiction. In Burroughs's books, Tarzan is the son of Lord Greystoke, an English nobleman. He is abandoned in Africa while a baby and is raised by a family of apes. He grows up in the jungle, learning the language and habits of the animals. Tarzan has many adventures and saves many lives.

Burroughs wrote the first Tarzan story in 1912. He published the first Tarzan book, *Tarzan of the Apes,* in 1914. Burroughs wrote more than 70 books, including 26 about Tarzan. Burroughs's works have sold more than 36 million copies and have been translated into more than 30 languages. Tarzan has been featured in numerous motion pictures, a radio serial, a television series, and a comic strip.

Burroughs also wrote many books of fantastic science fiction about life on other planets, beginning with the magazine serial, *Under the Moons of Mars* (1912). It was published in book form in 1917 as *A Princess of Mars.* Burroughs was born Sept. 1, 1875, in Chicago. He turned to writing after drifting through a number of laboring jobs and failed business ventures. Barbara M. Perkins

Burroughs, *BUR ohz,* **John** (1837-1921), an American naturalist, became widely recognized as a writer on outdoor life. Burroughs's writings made the beauties of the outdoors seem real to both children and adults. His description of birds, flowers, and a variety of natural settings in North America became increasingly poetic and philosophical over the course of his career.

Burroughs's works include the essays "Bird Enemies," "The Tragedies of the Nests," "An Idyl of the Honey-Bee," "Winter Neighbors," and "A Taste of Maine Birch." His books include *Bird and Bough* (1906), a collection of poems. Burroughs also wrote *The Light of Day* (1900), *Camping and Tramping with Roosevelt* (1907), *Time and Change* (1912), *The Summit of the Years* (1913), *The Breath of Life* (1915), and *Under the Apple-Trees* (1916).

Burroughs was born on April 3, 1837, in Roxbury, New York. He spent his youth on his father's farm, working, reading, and studying. He enjoyed the works of Ralph Waldo Emerson, Walt Whitman, Matthew Arnold, and John James Audubon. Burroughs's view of nature put him in the tradition of Henry David Thoreau and Emerson.

Burroughs published his first book, *Notes on Walt Whitman as Poet and Person* (1867), while a clerk in the United States Department of the Treasury in Washington, D.C. He left this post in 1873 and was a bank examiner for several years. He then moved to a farm in West Park on the Hudson River, where he had a log house called Slabsides. His friends and travel companions included Theodore Roosevelt, Thomas A. Edison, and Henry Ford. G. J. Kenagy

Burroughs, William (1855-1898), an American businessman and inventor, developed the printing-adding machine. His invention helped automate offices throughout the world.

Burroughs was born in Auburn, N.Y. He spent part of

his youth working as a bank clerk and became aware of the mistakes and boredom that resulted when adding long columns of numbers by hand.

Burroughs later moved to St. Louis, Missouri, and got a job in a machine shop. There he began work on inventing an adding machine. He formed a company and in 1888 patented a machine that could add a column of numbers and record its total. An improved model, patented in 1892, printed each entry and the total.

Burroughs died on Sept. 14 or 15, 1898. In his lifetime, the company sold few machines. But by 1913, the Burroughs Adding Machine Company was becoming a leader in office automation. His grandson William S. Burroughs, who was named for him, became a well-known experimental novelist. David F. Channell

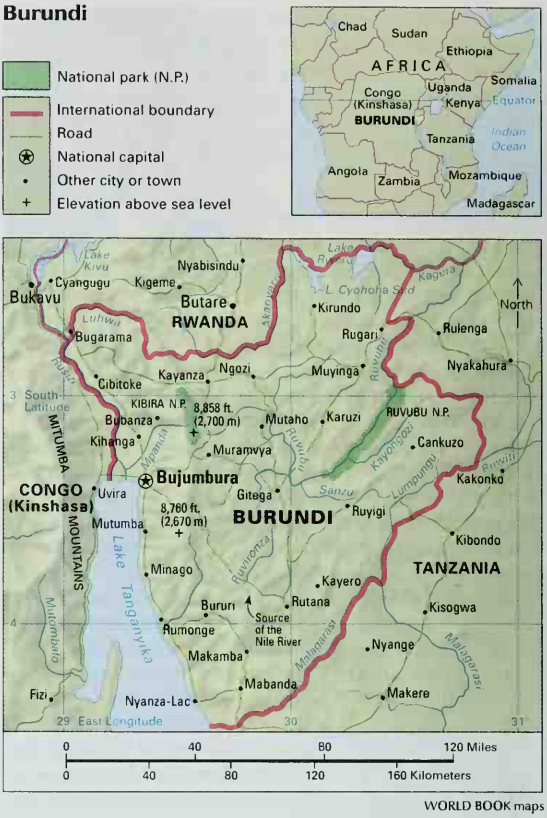
Bursitis, *buhr SY tihs,* is a disorder that causes pain in the body's joints. It most commonly affects the shoulder or hip joints. It is caused by an inflammation of the *bursa,* a small fluid-filled bag that acts as a lubricating surface for a muscle to move over a bone. This inflammation usually results from overactivity of an arm or leg. The shoulder or the hip becomes painful and difficult to move. Doctors treat bursitis by injecting cortisone drugs into the sac, or with heat, anti-inflammatory drugs, physical therapy, or *ultrasound* (high-pitched sound). Less common forms are elbow swellings, housemaid's knee, or bunions. See also **Bunion.** Michael D. Lockshin

Burton, Sir Richard Francis (1821-1890), was a British explorer and language expert who became famous for his travels in Africa and his translations of Arab literature. In 1858, Burton and fellow explorer John Hanning Speke became the first Europeans to see Lake Tanganyika in central Africa. Burton's best-known translation was a 10-volume English version of the *Arabian Nights* that he wrote in the 1880's. Burton also wrote about a dozen books about his travels. His two-volume *The Lake Regions of Central Africa* (1860) is a classic early account of the exploration of Africa.

Burton was born on March 19, 1821, in Devon, England. He served as a British officer in the Indian army from 1842 to 1861. In 1853, he disguised himself as an Arab to visit shrines in the holy Muslim city of Mecca. Only Muslims could enter Mecca, and Europeans had been killed after being discovered at shrines there. In 1860, Burton visited the United States to study the Mormons of Utah. He later explored areas in West Africa that are now Benin, Gabon, and Nigeria. Burton also served as a British diplomat in what is now Equatorial Guinea as well as in Brazil, Syria, and Italy. He was knighted in 1886 and died on Oct. 20, 1890. Robert I. Rotberg

Burundi, *buh RUHN dee* or *bu ROON dee,* is one of the smallest and most crowded countries in Africa. Bujumbura is its capital and largest urban community. Burundi is a poor country. It has few minerals and little industry. The country's soil has been weakened by heavy rainfall, erosion, and poor farming methods. A majority of the people of Burundi are farmers who raise only enough food to feed their families. Burundi is located far inland and, as a result, transportation of goods for overseas trade is costly. Burundi is in east-central Africa, just south of the equator. However, Burundi has a cool, pleasant climate, because it is a mountainous country.

A large majority of Burundi's people belong to the Hutu (sometimes called Bahutu) ethnic group. The Tutsi



WORLD BOOK maps

(sometimes called the Batutsi or Watusi) ethnic group form a minority of the population. The two groups speak the same language and share a common culture.

Burundi was a kingdom until 1884, when Germany colonized the region. The Germans merged Burundi with its northern neighbor, the kingdom of Rwanda, and governed them as the territory of Ruanda-Urundi. The region came under Belgian control during World War I (1914-1918). From 1946 to 1962, Ruanda-Urundi was a United Nations (UN) trust territory governed by Belgium. In 1962, Burundi and Rwanda became independent.

Government. In 1996, military leaders overthrew Burundi's government. In 2001, a transitional constitution

Facts in brief

Capital: Bujumbura.
Official languages: Kirundi and French.
Area: 10,747 mi² (27,834 km²). *Greatest distances*—north-south, 150 mi (249 km); east-west, 135 mi (217 km).
Population: *Estimated 2002 population*—7,044,000; density, 655 per mi² (253 per km²); distribution, 92 percent rural, 8 percent urban. *1990 census*—5,139,073.
Chief products: *Agriculture*—bananas, beans, cassava, coffee, corn, cotton, livestock, sweet potatoes, tea. *Fishing*—freshwater fish.
Flag: From a white circle in the center, white bands extend to the corners. The field is red above and below the circle, and green to the left and right of it. In the circle are three red stars rimmed in green. See **Flag** (picture: Flags of Africa).
Money: *Basic unit*—franc. One hundred centimes equal one franc.

© F. and H. Schreider, Photo Researchers

A coffee farm-worker in Burundi picks berries that contain beans from which coffee is made. Coffee ranks as Burundi's most important crop grown for export.

was adopted, and a transitional multiparty government was installed for a three-year period. The government includes a president, a vice president, and a legislature that consists of a 121-member National Assembly and a 51-member Senate.

People. Approximately 85 percent of Burundi's people belong to the Hutu ethnic group, and about 14 percent to the Tutsi group. Most of the rest of the people belong to a Pygmy group called the Twa. Small groups of Arabs, Asians, and Europeans also live in Burundi.

Since colonial times, the Tutsi, though a minority, have held most of the country's wealth and controlled the military. Many Tutsi own cattle and other livestock. Most of the Hutu are farmers who often struggle to raise enough food to feed their families. Many of the Twa make pottery and raise crops.

French and Kirundi are the official languages. Most of the people speak Kirundi, a Bantu language (see **Bantu**). The vast majority of the people are Roman Catholics. Roman Catholic missionaries operate most of the schools.

Land. Burundi's western border runs along the Great Rift Valley. This area contains the northern part of Lake Tanganyika and the Rusizi River. The northwestern part of Burundi rises from the valley to over 8,800 feet (2,680 meters) above sea level. Most of western Burundi is volcanic rock, and soils formed on volcanic rock are usually fertile. But heavy rains have washed out most of the useful chemicals in the soil there. Poor farming methods have also weakened the soil and worn it away.

Plateaus that are bordered by *escarpments* (steep slopes) cover central and eastern Burundi. Swamps lie at the foot of the escarpments. Woodlands once covered most of the plateaus, but farmers have cleared most of the land. The soils there produce better crops than those in western Burundi. Another highland region covers southern Burundi.

The Great Rift Valley region around Bujumbura has an average temperature of 73 °F (23 °C) and an average annual rainfall of 30 inches (76 centimeters). The mountainous western region of the country has an average temperature of 63 °F (17 °C) and an average annual rainfall of about 58 inches (147 centimeters). On the plateaus, temperatures average 68 °F (20 °C) and about 47 inches (119 centimeters) of rain falls a year. The rainy season in Burundi generally lasts from February to May.

Economy. The people raise bananas, beans, cassava, corn, and sweet potatoes for food. Some people also raise cattle and other livestock. Coffee is the most important crop grown for export. Other exports include tea and cotton. Burundi has deposits of peat and nickel.

Farmers raise *robusta* coffee (the type used in instant coffee) in areas up to about 4,500 feet (1,370 meters) above sea level. The more valuable *arabica* coffee, used in regular brewing, is grown on land 4,500 to 6,000 feet (1,370 to 1,800 meters) above sea level.

Fish are an important food for many people in Burundi. Lake Tanganyika is a major source of fish.

Most of Burundi's roads are unpaved, and the country has no railroads. Boats on Lake Tanganyika carry goods between Bujumbura and Kigoma in Tanzania, and Kalemie in Congo (Kinshasa). Bujumbura has an international airport. Shipping routes to the ocean are long. Overseas trade is expensive and difficult because goods must be loaded and unloaded from ships and railroad cars many times before they reach their destination.

History. Twa people were probably the first inhabitants of what is now Burundi. They may have lived in the area in prehistoric times. Bantu-speaking farmers arrived sometime during the first several hundred years after the time of Jesus Christ. These people, the ancestors of the present-day Hutu, eventually became the largest group in Burundi. Historians believe that the Tutsi arrived from northeastern Africa sometime during the 1300's or 1400's. A kingdom was established with two groups of citizens: cattle herders (the Tutsi) and farmers (the Hutu). Burundi was ruled by a small group of aristocrats known as the Ganwa. The Ganwa were of Tutsi descent, but they were considered neither Hutu nor Tutsi. They ruled both the Hutu and the Tutsi and gained much wealth. Burundi also had a king called the *mwami,* but his authority was restricted by the Ganwa.

In 1897, the Germans occupied the area that is now Burundi and Rwanda. The area, then called Ruanda-Urundi, became part of German East Africa. Belgium occupied the country in 1916, during World War I. In 1923, Ruanda-Urundi became a mandated territory under Belgian administration (see **Mandated territory**). In 1946, the United Nations made Ruanda-Urundi a trust territory under Belgian administration (see **Trust territory**). In 1961, Urundi voted to become the independent monarchy of Burundi, and Ruanda voted to become the republic of Rwanda. The two became independent on July 1, 1962. By then, the power of the Ganwa had ended, and the Tutsi controlled Burundi.

After Burundi's independence, ill-feeling between the Hutu and Tutsi led to almost continual unrest. In 1965,

assassins killed Prime Minister Pierre Ngendandumwe. Later that year, army rebels shot Ngendandumwe's successor, Leopold Biha. Biha recovered but was replaced by Michel Micombero, Burundi's military leader. In 1966, Micombero overthrew the king. He established Burundi as a republic and declared himself president. In 1972, an unsuccessful revolt by the Hutu against the Tutsi resulted in about 100,000 deaths, most of them Hutu. In 1976, Colonel Jean-Baptiste Bagaza became president after leading a coup against the government.

Under Bagaza, relations between Burundi's government and the Roman Catholic Church deteriorated. Religious services could not be held without government permission. Discontent within the army over the relations between church and state led to the overthrow of Bagaza in 1987. Major Pierre Buyoya succeeded Bagaza.

In 1966, the Union for National Progress had become Burundi's only legal political party. Other parties were legalized in 1993, and Burundi held its first multiparty elections in June of that year. Melchior Ndadaye won the elections and became the first Hutu to serve as Burundi's president. In October 1993, a military coup overthrew Ndadaye's government and killed Ndadaye. In January 1994, Cyprien Ntaryamira, also a Hutu, was named interim president by the National Assembly. Ntaryamira and President Juvenal Habyarimana of Rwanda were killed in a plane crash in April 1994. Sylvestre Ntibantunganya, another Hutu, was then named president. Since the 1993 coup, frequent violent clashes have occurred between the Hutu and Tutsi. In July 1996, the Tutsi-led military overthrew Ntibantunganya's government, and appointed Buyoya president.

Michael Chege

See also **Bujumbura; Hutu; Ruanda-Urundi; Rwanda; Tutsi.**

Burying beetle, also called *sexton beetle,* is a type of insect that buries small dead animals and birds. The keen sense of smell of burying beetles guides them to dead mice or other small animals. The beetles dig around and under the body until the animal is about 5 inches (13 centimeters) below the surface. Then the female beetle lays her eggs in the body. The eggs hatch in about two weeks, and the young beetles eat the flesh of the dead animal until they are mature. Burying beetles grow to be about 1 to 1 $\frac{1}{2}$ inches (2.5 to 3.8 centimeters) long. They have thick bodies with red markings.

David J. Shetlar

Scientific classification. Burying beetles are in the carrion beetle family, Silphidae. One kind is *Nicrophorus marginatus.*

Bus is a vehicle that carries passengers along streets and highways. Millions of people depend on buses to transport them to and from school, shopping areas, and work. Many people also take buses for special group trips or to travel between towns.

In many countries, including the United States, buses are the most common form of mass transportation. Bus travel reduces the number of automobiles on the road, and so improves traffic flow, saves fuel, and reduces air pollution. Buses cost less to operate and use less fuel to carry a passenger a given distance than do most other passenger vehicles Buses also have a good safety record, especially compared with cars. In less developed countries, bus travel is one of the cheapest forms of motorized transportation.

Manufacturers build buses in various sizes and styles. Buses may seat as few as 8 passengers or as many as 70. Most run on diesel fuel, gasoline, or liquefied petroleum gas. Some local buses operate on electric power. Some buses are *articulated*—that is, they consist of two sections that are connected by a flexible cover. Double-deck buses are common in many European countries, and they are often used for sightseeing. *Over-the-road buses* are equipped for traveling long distances. They generally have an elevated passenger deck over a baggage compartment. Such buses are also called *motor coaches* in North America, and *coaches* in the United Kingdom and other English-speaking countries.

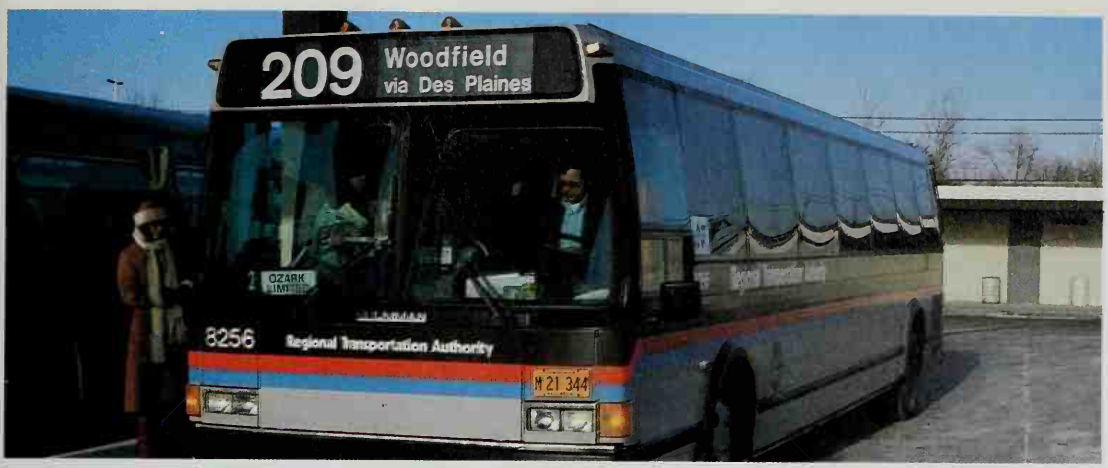
Kinds of bus service

There are four chief kinds of bus services. They are provided by (1) intercity buses, (2) local-transit buses, (3) school buses, and (4) special buses.

Intercity buses carry passengers, mail, and packages between cities or towns. Trips between cities may be as short as an hour or as long as several days. Intercity buses provide the only form of mass transportation between many cities, towns, and rural areas.

WORLD BOOK photo by Cameramann International, Ltd.

School buses such as this one carry large numbers of elementary and high school students from home to school and back.



WORLD BOOK photo

A local bus carries passengers within a specific area. Local transit agencies often operate such buses. Buses are the chief form of public transportation in the United States.

Local-transit buses operate only within a specific area, such as the boundaries of a city. In metropolitan areas, buses carry thousands of people to and from their jobs each workday. Some people use buses because they do not own a car. Others find it easier or cheaper to take a bus than to drive. Many cities urge people to travel by bus rather than by car. In many cities, buses have their own highway lanes to speed commuters to work. In Seattle, Washington, buses can travel through a bus tunnel under the most congested parts of the city. Local-transit bus services may be managed by a city or local government as a public service. Some are *subsidized* (supported) with money from local or national taxes.

School buses carry students to and from school. They are operated by the schools or by companies under contract to the schools. In the United States, most school buses have a bright yellow-orange color.

Special buses include shuttle buses, tour buses, and sightseeing buses. Shuttle buses make short runs from one point to another, such as between buildings on a university campus, or between a hotel and an airport. Tour buses are hired for group trips. Sightseeing buses follow special routes to show local sights to visitors.

Bus regulations

In many countries, regulations govern bus fares, routes, and services run by both private and public transportation companies. Bus drivers usually have to pass special driving and medical tests. Other regulations deal with such matters as speed limits, the number of passengers that a bus may carry, vehicle safety standards, and the hours a bus driver may work. In the United States, each state licenses bus drivers in accordance with both its own and federal standards and specifies the height, length, weight, and speed of intercity and local-transit buses within its borders.

The Americans with Disabilities Act (ADA), passed in 1990, requires public transportation systems in the United States to ensure that new or renovated buses operating over fixed routes be accessible to disabled riders. These buses must include such features as lifts for people in wheelchairs and signs in braille for blind riders. Private over-the-road bus companies must provide disabled-accessible buses on demand. School buses are not covered by the ADA.

History

The first city buses, which were drawn by horses, appeared in Paris in 1662. Beginning in the early 1800's, in Europe and the United States, horse-drawn buses were called *omnibuses,* from a Latin word that means *for all.* Buses powered by gasoline engines first appeared in Germany in the 1890's. These early buses were automobiles lengthened to hold extra passengers. The first regular bus service in the United States began in New York City in 1905. Poor roads and the hard, solid rubber tires of the buses made bus travel uncomfortable. Improved roads and air-filled tires soon made buses more pleasant to ride. Intercity and local bus service grew rapidly during the 1930's and 1940's.

Bus services began to decline in industrialized countries in the 1950's as more people bought their own automobiles. In addition, airplanes have become the chief means of transportation for long trips. Nevertheless, local-transit bus services will continue to be a popular form of mass transportation worldwide. Peter J. Pantuso

See also Transit.

Bush is any woody plant that is smaller than a tree and does not climb. A bush has many branches, but no main central stem. Azalea, barberry, currant, forsythia, gooseberry, hazelnut, lilac, manzanita, privet, pussy willow, and rhododendron are familiar bushes. Some roses are bushes, but others are climbers.

The word *bush* is sometimes used interchangeably with *shrub.* But the two words do not have exactly the same meaning. A shrub does not necessarily have many branches. An herb such as tumbleweed, which has a broadly rounded form with many branches, is bushy-branched but not shrubby. See **Shrub**.

People often refer to any large wild area covered with trees and bushes as *bush.* The San people of Africa are sometimes called *Bushmen* (see **San**). David S. Seigler

41st president of the United States 1989-1993

Reagan
40th president
1981-1989
Republican

Bush
41st president
1989-1993
Republican

Clinton
42nd president
1993-2001
Democrat

Dan Quayle
vice president
1989-1993

David Valdez, The White House

Bush, George Herbert Walker (1924-), served as president of the United States from 1989 to 1993. In 1988, he defeated the Democratic Party's presidential candidate, Governor Michael S. Dukakis of Massachusetts. In 1992, Bush was defeated in his bid for a second term by Governor Bill Clinton of Arkansas, his Democratic opponent. Bush had served as vice president under President Ronald Reagan from 1981 to 1989.

Bush became president at a time when many Americans were uncertain about their country's future. The federal government was badly in debt, the result of several years of budget *deficits* (shortages). In addition, the value of goods imported into the United States far exceeded the value of exports, leading many people to fear that the nation was becoming a second-rate economic power.

In the 1988 election, Bush took advantage of his association with Reagan, who was an extremely popular president. Bush profited as well from the fact that relations between the United States and the Soviet Union had improved greatly during the Reagan presidency.

As president, Bush led the nation during the Persian Gulf War, in which the United States and its allies defeated Iraq. He also signed important arms-control agreements with the Soviet Union and, after it broke apart, with Russia and other former Soviet republics. But critics claimed that Bush failed to deal effectively with economic and other problems in the United States.

Bush was the 14th former vice president who became president. Before his election as vice president, Bush had a long career of government service. A Texas Republican, he served two terms in the U.S. House of Representatives. Bush also held several key appointed positions in the national government. These posts included U.S. ambassador to the United Nations (UN) and director of the Central Intelligence Agency (CIA).

Bush was a successful businessman in the oil industry before entering politics. A native of New England, Bush was drawn to Texas by the booming oil industry. He worked his way up from equipment clerk to become president of an independent offshore oil drilling firm. He liked sports, especially tennis and baseball. Bush also enjoyed boating, fishing, and spending time with his family at their vacation home in Kennebunkport, Maine.

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Early life

Boyhood. Bush was born on June 12, 1924, in Milton, Massachusetts. He had three brothers—Prescott, Jr.,

Important dates in Bush's life

1924 (June 12) Born in Milton, Massachusetts.
1942-1945 Served in the U.S. Navy during World War II.
1945 (Jan. 6) Married Barbara Pierce.
1948 Graduated from Yale University.
1954 Became president of Zapata Off-Shore Company.
1967-1971 Served in U.S. House of Representatives.
1971-1973 Served as U.S. ambassador to the United Nations.
1974-1975 Served as U.S. envoy to Communist China.
1976-1977 Served as head of Central Intelligence Agency.
1980 Elected vice president of the United States.
1984 Reelected vice president.
1988 Elected president of the United States.
1992 Lost presidential election to Bill Clinton.

Communist rule ended in most Eastern European countries and the Soviet Union by late 1991. At the left, a statue of V. I. Lenin, the founding father of Soviet Communism, is being dismantled in Lithuania in 1991.

Riots broke out in Los Angeles in 1992 after a jury did not convict four white policemen of assaulting a black motorist. The riots increased U.S. concern over racial tensions.

The world of President Bush

The Soviet Union broke apart into a number of independent states in late 1991, after the Communist Party lost control of the government. In addition, Communist rule ended in most Eastern European countries during the late 1980's and early 1990's. Many people felt that these and other events marked the end of the Cold War.

The largest oil spill in United States waters occurred in 1989 when the U.S. tanker *Exxon Valdez* released about 11 million gallons (42 million liters) of crude oil into the Pacific Ocean near Alaska.

The Americans with Disabilities Act of 1990 protected disabled people from discrimination by private employers.

The Hubble Space Telescope, launched into orbit by the United States in 1990, produced valuable new images of stars, planets, and galaxies.

The Persian Gulf War was fought in early 1991 between Iraq and a coalition of 39 countries, including the United States. The coalition quickly defeated Iraq.

Recycling programs multiplied as the world's output of garbage became a growing concern.

A cyclone and tidal wave struck Bangladesh in 1991. About 150,000 people died in the disaster.

South Africa officially ended apartheid, its policy of racial segregation, in 1991. However, the country's laws continued to deny blacks the right to vote in national and provincial elections.

Hurricane Andrew tore through southwestern Florida in 1992, leaving as many as 250,000 people homeless.

© Allan Tanenbaum, Sygma; East News from Sipa Press

Jonathan, and William—and a sister, Nancy.

George's parents were Prescott Sheldon Bush and Dorothy Walker Bush. Prescott Bush was a successful businessman who eventually became a managing partner in an investment banking firm. He later developed an interest in politics. Prescott Bush represented Connecticut in the U.S. Senate from 1952 to 1963.

When George was less than a year old, his family moved to Greenwich, Connecticut. His upbringing was comfortable but strict. His family spent summers at the Kennebunkport home of Dorothy Bush's father, George Herbert Walker, for whom young George was named.

George attended the private Greenwich Country Day School. He then entered Phillips Academy at Andover, Massachusetts, an exclusive preparatory school. Bush earned good grades and was elected president of the senior class. He also was captain of the baseball and soccer teams. Bush graduated in 1942.

WORLD BOOK photo by Jennifer Podis

Bush's birthplace was this house in Milton, Massachusetts. When Bush was less than a year old, his family moved to Greenwich, Connecticut, where he spent his boyhood years.

War hero. The United States entered World War II (1939-1945) in December 1941. Bush enlisted in the U.S. Naval Reserve. He received flight training and was commissioned an ensign in June 1943. At that time, he was the Navy's youngest pilot.

In 1943, Bush became a pilot with Torpedo Bomber Squadron VT-51, aboard the aircraft carrier U.S.S. *San Jacinto* in the Pacific Ocean. On Sept. 2, 1944, his plane was shot down during an attack on a Japanese-held island. Before parachuting from his plane, Bush scored damaging hits on his target, a radio station. A submarine, the U.S.S. *Finback,* rescued Bush from the ocean, but his two crew members did not survive. Bush received the Distinguished Flying Cross for his heroism in the incident. He returned to flying after being shot down. Bush later served at the Oceana Naval Air Station in Virginia until the war ended in August 1945.

Bush's family. Bush met Barbara Pierce of Rye, New York, at a Christmas dance in 1941. Her father, Marvin Pierce, was the publisher of *McCall's* and *Redbook* magazines. George and Barbara married on Jan. 6, 1945, while Bush was on leave from naval duty. They had six children—George; Robin, who died of leukemia; John, called Jeb; Neil; Marvin; and Dorothy. Their son George was elected governor of Texas in 1994 and reelected in 1998. He was elected president of the United States in 2000, defeating his Democratic opponent, Vice President Al Gore. Jeb Bush was elected governor of Florida in 1998.

College education. In the fall of 1945, George entered Yale University. He played first base on the Yale

The White House

Bush married Barbara Pierce of Rye, New York, on Jan. 6, 1945, after he returned from active duty in the Pacific. The two first met at a Christmas dance in 1941.

baseball team for three seasons. Bush graduated from Yale in 1948 with a bachelor's degree in economics. He also was elected to the honor society Phi Beta Kappa.

Business career

Entry into the oil business. After his graduation from Yale, Bush received an offer to join his father's investment banking firm. But he turned down this secure position to try his luck in the oil fields of Texas. A family friend offered Bush a job at Dresser Industries, an oil-equipment company. Bush started with Dresser Industries as an equipment clerk in Odessa, Texas.

After a little less than a year, Bush was transferred to California, where he worked as an assemblyman in an oil-equipment factory and as a salesman of drilling bits. In 1950, Bush was transferred back to Texas. He and his family settled in Midland.

Independent oilman. In late 1950, Bush left Dresser Industries. He and a friend, John Overbey, formed the Bush-Overbey Oil Development Company. The company bought a percentage of mineral rights on land where oil was drilled and sought investors to finance its ventures.

In 1953, Bush and Overbey joined brothers Hugh and William Liedtke and formed the Zapata Petroleum Corporation. The new company absorbed Bush-Overbey. In 1954, the corporation created Zapata Off-Shore Company to drill for oil in the Gulf of Mexico. Bush became president of this company, which was made independent of the Zapata Petroleum Corporation in 1959. That year, Bush moved its headquarters to Houston. Bush's career as an independent oilman made him wealthy.

Early political career

Bush became more interested in politics in the late 1950's. In 1962, he was elected chairman of the Republican Party of Harris County—the county in which most of Houston lies. In 1964, he was the Republican candidate for the U.S. Senate. Democratic incumbent Ralph Yarborough defeated Bush in the general election.

In 1966, Bush ran for the U.S. House of Representatives from Texas's Seventh Congressional District. He defeated his Democratic opponent, Frank Briscoe. Bush generally voted conservatively in the House. But he supported some liberal bills, including one calling for elimination of the military draft. He also supported a bill to guarantee open housing to minorities. Bush was reelected to the House without opposition in 1968.

In 1970, partly due to encouragement by President Richard M. Nixon, Bush gave up his seat in the House to make another run for the Senate. But he was defeated in the general election by Democrat Lloyd Bentsen.

Appointive positions

United Nations ambassador. President Nixon appointed Bush U.S. ambassador to the UN in December 1970. In 1971, Bush worked to allow Nationalist China to keep its position in the UN. He supported a "dual representation" plan that would accept the entry of Communist China to the UN while preserving Nationalist China's position there. However, the members of the UN voted to expel Nationalist China. Bush's efforts were complicated by gestures of friendship made toward Communist China by the Nixon Administration.

Republican Party chairman. After his reelection in 1972, President Nixon appointed Bush chairman of the Republican National Committee. Bush took over the post in January 1973—just before the events of the Watergate scandal became known to the public. The scandal involved illegal activities by key Republicans who were working to reelect Nixon. Their actions included burglary, wiretapping, and sabotage, and the subsequent cover-up of these criminal activities (see **Watergate**).

Bush believed Nixon's claim that he had played no part in either the break-in or the cover-up, and he defended the president against harsh criticism. Bush also worked to separate the illegal actions of a few Republicans from the integrity of the Republican Party. But secret White House tape recordings later provided convincing evidence that Nixon had played a part in the Watergate scandal, and Nixon faced almost certain impeachment by the House and removal from office by the Senate. On Aug. 7, 1974, Bush requested Nixon's resignation in the name of the Republican Party. Nixon announced his resignation the following day. He officially left office on August 9.

Envoy to China. In 1974, Nixon's successor, Gerald R. Ford, let Bush select his next government assignment. Bush chose to head the United States Liaison Office in Beijing, the capital of Communist China. Bush worked to continue developing relations between the two countries, which had opened diplomatic offices in each other's capitals in 1973.

CIA director. In November 1975, President Ford requested that Bush return to Washington to head the Central Intelligence Agency. Bush accepted. The Senate confirmed his appointment in January 1976 after imposing the condition that Bush not be considered as a candidate for vice president in 1976.

When Bush took over the CIA, congressional committees were carefully examining its past activities. Bush's most vital contribution was in raising staff morale during this difficult period. He worked to improve the manage-

ment of the agency. Bush left the CIA in January 1977, having resigned after the election of Democratic President Jimmy Carter in November 1976.

The 1980 election

Campaign for the presidential nomination. In the fall of 1977, Bush and his advisers began to raise funds for the 1980 campaign for the presidency. Bush officially announced his candidacy in May 1979. In January 1980, Bush defeated his chief rival for the nomination, former California Governor Ronald Reagan, in the Iowa caucuses, the first contest in the nominating process. But Bush could not maintain this advantage, as Reagan accumulated victories in primary elections. Bush withdrew his candidacy on May 26, 1980.

Vice presidential candidate. The Republican National Convention, held in Detroit in July 1980, officially nominated Reagan as the party's presidential candidate. Reagan invited Bush to be his vice presidential running mate. Bush accepted and was formally nominated.

Bush did not completely share Reagan's views on such issues as cutting federal taxes, abortion, and the Equal Rights Amendment. However, Bush minimized his differences with Reagan during the campaign. Reagan and Bush defeated the Democratic ticket of President Jimmy Carter and Vice President Walter Mondale in the general election in November 1980.

Vice president

Reagan's first administration. Reagan and Bush quickly established a warm, friendly working relationship. Bush was given an office in the White House and allowed free access to the president.

Reagan gave Bush a more active role than most previous vice presidents had enjoyed. Bush attended daily security briefings held for the president and received key intelligence information. Reagan appointed Bush chairman of several important groups, including the National Security Council's crisis management team and a special task force that investigated drug smuggling and illegal immigration in Florida. Bush attended Reagan's Cabinet meetings. But he rarely spoke there, so as not to differ publicly with the president. Rather than contradict Reagan, Bush advised him privately and confidentially. In particular, Bush encouraged Reagan to be open to the possibility of negotiation with the Soviet Union.

On March 30, 1981, Reagan was shot in an attempted assassination. The event thrust Bush into the national spotlight. Just after the shooting, Bush assured the United States and the world that national affairs were under control. Bush also took over some of Reagan's public duties during the president's recovery. Bush's performance won him much respect during this period.

Reagan's second administration. Reagan and Bush easily won renomination at the 1984 convention of the Republican Party in Dallas. The Democrats nominated former Vice President Mondale for president and Representative Geraldine Ferraro of New York for vice president. Reagan and Bush won the general election by a landslide. During the second Reagan administration, Bush continued to influence Reagan. On July 13, 1985, Bush served as acting president for about eight hours when Reagan underwent cancer surgery.

Election as president

The Republican nomination. Bush entered the 1988 campaign with distinct advantages over his Republican rivals. He had served as vice president under a popular president, and his name was well known among voters. Bush also had a well-organized, well-financed campaign. His rivals included Senator Robert Dole of Kansas and Pat Robertson, a former television evangelist.

Dole dealt Bush a surprising defeat in the Iowa caucuses in February 1988. He questioned Bush's claim of ignorance in the Iran-contra affair—a complex, illegal scheme in which officials in the United States indirectly sold weapons to Iran and then used the profits to help the *contras,* a group of rebels fighting to overthrow the government of Nicaragua. But Bush quickly recovered with a string of primary victories. The remaining Republican candidates soon withdrew because Bush had won enough delegates to ensure his nomination.

At the Republican National Convention in New Orleans in August 1988, Bush was named the Republican presidential nominee. At his request, Senator Dan Quayle of Indiana was nominated for vice president. The Democrats nominated Governor Michael S. Dukakis of Massachusetts for president and Senator Lloyd Bentsen of Texas, who had defeated Bush in the 1970 Senate race, for vice president.

The 1988 election. Many Republicans hoped that Bush could win the support of the conservative Democrats who had crossed party lines to vote for Reagan in 1980 and 1984. Many of Bush's conservative views, particularly those concerning the smuggling of illegal drugs into the United States, were similar to those of

AP/Wide World

At the 1984 Republican convention in Dallas, President Ronald Reagan and Vice President Bush were nominated for reelection. Nancy Reagan and Barbara Bush joined their husbands onstage.

Reagan. Bush also promised not to increase any taxes.

Dukakis questioned Bush's lack of knowledge of the Iran-contra affair. The Democrats also criticized Bush for his role in the Reagan presidency, claiming that illegal drug trafficking had flourished and that social services had been cut during Reagan's administration. Bush, in turn, criticized Dukakis's record as governor of Massachusetts, charging—among other things—that the governor had been lax in protecting the environment and had been too "soft" on criminals. Bush also questioned Dukakis's lack of experience in foreign policy and argued that the Democrats would increase taxes and weaken the nation's military. In the general election, Bush and Quayle defeated Dukakis and Bentsen. Bush received 426 of the 538 electoral votes.

Bush's administration (1989-1993)

National affairs. Early in his presidency, Bush had to deal with the worst crisis in the savings and loan industry since the Great Depression of the 1930's. Savings and loan institutions provide, among other things, loans for building or buying homes. From 1980 to 1990, more than 1,000 of these institutions failed, and hundreds more neared bankruptcy. The crisis resulted from several factors, including customers' nonpayment of loans, poor regulation, and fraud and mismanagement in the industry. Soon after entering office, Bush proposed legislation to rescue and restructure the industry. This bailout in time cost taxpayers many billions of dollars.

Concern for the environment also increased during Bush's presidency. In March 1989, the United States experienced the largest oil spill in U.S. history. The spill occurred after the U.S. tanker *Exxon Valdez,* owned by the Exxon Corporation (now part of Exxon Mobil Corporation), struck a reef near the port of Valdez, Alaska. Nearly 11 million gallons (42 million liters) of crude oil spilled into Prince William Sound, polluting fishing waters and destroying wildlife. Many people became dissatisfied with Exxon's cleanup. Two weeks after the spill, Bush ordered the U.S. military and other federal agencies to take over the cleanup work.

In November 1990, Bush signed into law a bill that amended the Clean Air Act of 1970. The amendments set stricter standards for air quality and *emissions* (release of pollutants) and required the sale of cleaner burning fuels. But some critics charged that Bush did not do enough to protect the environment. They criticized his refusal to support specific limits on the country's emissions of carbon dioxide and other gases believed to contribute to global warming (see **Global warming**).

Also in November 1990, Bush signed legislation that raised federal taxes. He claimed the increases were needed to reduce the federal budget deficit. However, Bush's action contradicted his 1988 presidential campaign promise to oppose any new taxes.

Trippett/Witt, Sipa

Bush and Senator Dan Quayle of Indiana, *left,* became the Republican nominees for president and vice president at the party's national convention in New Orleans in August 1988.

In 1991, economists said that the U.S. economy had entered a recession in July 1990. By June 1991, 7 percent of the nation's civilian workers were unemployed. Bush urged bank regulators to lower interest rates to help end the recession. The economy slowly began to grow in 1991, but unemployment remained high.

Many people felt that Bush failed to deal effectively with the country's economic and other domestic problems. The nation continued to suffer from high rates of drug abuse, homelessness, and violent crime. In addition, plans to reform the country's banking, educational, and health care systems remained unresolved. Many

Bush's election

Place of nominating convention	New Orleans
Ballot on which nominated	1st
Democratic opponent	Michael S. Dukakis
Electoral vote*	426 (Bush) to 111 (Dukakis) and 1 (Bentsen)
Popular vote	48,886,097 (Bush) to 41,809,074 (Dukakis)
Age at inauguration	64

*For votes by states, see **Electoral College** (table).

Vice president and Cabinet

Vice president	* Dan Quayle
Secretary of state	* James A. Baker III Lawrence Eagleburger (1992)
Secretary of the treasury	* Nicholas F. Brady
Secretary of defense	* Richard B. Cheney
Attorney general	Richard L. Thornburgh William P. Barr (1991)
Secretary of the interior	* Manuel Lujan, Jr.
Secretary of agriculture	Clayton K. Yeutter Edward R. Madigan (1991)
Secretary of commerce	Robert A. Mosbacher Barbara H. Franklin (1992)
Secretary of labor	* Elizabeth H. Dole Lynn M. Martin (1991)
Secretary of health and human services	* Louis W. Sullivan
Secretary of housing and urban development	* Jack F. Kemp
Secretary of transportation	Samuel K. Skinner Andrew H. Card, Jr. (1992)
Secretary of energy	James D. Watkins
Secretary of education	* Lauro F. Cavazos Lamar Alexander (1991)
Secretary of veterans affairs	Edward J. Derwinski

*Has a separate biography in *World Book.*

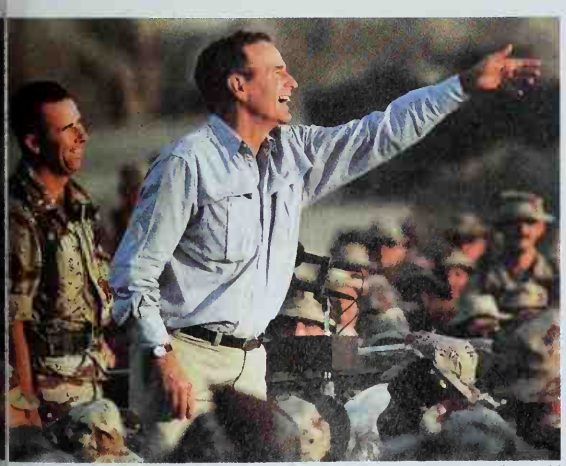
critics blamed the continuing problems on a lack of cooperation between Bush and Congress, which was controlled by the Democratic Party.

In the spring of 1992, Bush faced one of the worst domestic crises of his presidency when riots broke out in Los Angeles and other United States cities. The riots erupted after a jury decided not to convict four white Los Angeles police officers of assaulting an African American motorist named Rodney G. King. No African Americans had served on the jury. The jury's decision shocked many people because a videotape showing the officers beating King had been broadcast by TV stations throughout the country. The rioting that followed the decision occurred mainly in African American areas of Los Angeles. The Los Angeles riots resulted in 53 deaths and over $1 billion in property damage.

After the riots, Bush sent 5,000 federal troops and law enforcement officers to Los Angeles to help restore order. He also released federal funds for rebuilding the damaged area. In addition, Bush promised to support programs to help poor areas of U.S. cities. In April 1993, after the end of Bush's presidency, a federal jury convicted two of the officers of violating King's civil rights. In 1994, a civil court ordered the city of Los Angeles to pay King about $3 $\frac{3}{4}$ million in damages.

International affairs. Bush took bold military action twice during his presidency. He ordered U.S. troops to Panama in December 1989 and to the Persian Gulf region in August 1990.

Invasion of Panama. Bush ordered troops into Panama to overthrow the dictatorship of General Manuel Antonio Noriega. Bush said the action was necessary to protect the lives of 35,000 Americans who lived in Panama. He also cited U.S. obligations to defend the Panama Canal, the killing of a U.S. marine by Panamanian soldiers earlier in December 1989, and the intention to bring Noriega to the United States to face trial on drug trafficking charges. After Noriega's overthrow, the U.S. government cooperated with the new Panamanian president, Guillermo Endara. Earlier in 1989, Noriega had declared invalid the results of Panama's presidential election that apparently was won by Endara. In January 1990, Noriega surrendered to U.S. officials and was taken to the United States. In 1992, he was convicted of drug trafficking and sentenced to 40 years in prison.



AP/Wide World

On a visit to U.S. troops in Saudi Arabia in November 1990, President Bush tosses presidential tie clips to the group. Bush had ordered troops to the Middle East after Iraq invaded Kuwait.

Persian Gulf War. Bush ordered hundreds of thousands of U.S. troops to the Middle East after Iraq invaded and took over Kuwait in August 1990. Kuwait is an oil-rich country bordering Iraq and Saudi Arabia. Saudi Arabia and Kuwait were U.S. allies and produced much of the petroleum consumed by the United States and many other industrialized countries. Bush sent the troops to prevent a possible Iraqi attack on Saudi Arabia, and he and several other world leaders demanded that Iraq withdraw from Kuwait. Bush also ordered U.S. Navy ships to help enforce a UN embargo on the shipment of goods to and from Iraq.

Many Arab countries and other nations joined the United States in a coalition against Iraq. In November 1990, the UN Security Council authorized coalition members to "use all necessary means" to expel Iraq from Kuwait if Iraq did not withdraw by Jan. 15, 1991. Iraqi forces failed to leave Kuwait by the UN deadline. As a result, the Persian Gulf War began on January 17 in Iraq (January 16 U.S. time).

On orders from Bush, U.S. forces joined other coalition members in bombing Iraqi targets in Iraq and Kuwait. The military effort to force Iraq out of Kuwait became known as Operation Desert Storm. Bush also ordered U.S. participation in a massive ground attack that began on February 24 (February 23 U.S. time). In this attack, coalition troops entered Iraq and Kuwait and defeated Iraq's military after about 100 hours of fighting.

In April, Bush ordered U.S. troops into northern Iraq to work with other coalition forces in establishing a safety zone for Kurdish refugees. Kurds in Iraq had rebelled soon after Iraq's defeat in the Persian Gulf War. Iraq's army quickly put down the rebellion, and more than a million Kurds fled to the mountains of northern Iraq and to Iran and Turkey. Thousands died of disease, exposure, hunger, or war wounds. Besides protecting the refugees from Iraqi troops, the United States helped provide the Kurds with food and other necessities. The U.S. troops stayed in northern Iraq until July. By that time, most of the refugees had returned to their homes.

U.S.-Soviet relations. Bush worked to improve relations with the Soviet Union. In 1989, he met with Soviet President Mikhail Gorbachev on Soviet ships off the coast of Malta. The two leaders reached no formal agreements. But they stressed greater cooperation between their countries. In late May and early June 1990, Bush met with Gorbachev in the United States. At that meeting, the two presidents agreed to destroy most of their countries' *chemical weapons.* Chemical weapons include bombs that contain poison gases. The leaders also signed agreements to improve trade and economic relations between the two countries.

After Iraq invaded Kuwait, Bush met twice with Gorbachev to discuss the Persian Gulf crisis. The first meeting occurred in September 1990 in Helsinki, Finland. The second took place in November in Paris. At the Paris meeting, Bush sought Soviet support for a UN Security Council resolution authorizing the use of force to expel Iraq from Kuwait. The resolution passed later that month with Soviet approval. Also in November, Bush, Gor-

bachev, and other world leaders signed the Treaty on Conventional Armed Forces in Europe (CFE), which called for the destruction of large numbers of tanks and other nonnuclear weapons in Europe. A revised form of the CFE was signed and put into effect in 1992.

In July 1991, Bush and Gorbachev met in Moscow to sign the Strategic Arms Reduction Treaty, now called START I. The treaty required each of the two countries to reduce the number of its long-range nuclear bombers and missiles by about a third over a period of seven years. Final approval required ratification by both countries. START I became the first treaty to call for a reduction in existing numbers of long-range nuclear weapons.

In September 1991, Bush announced that the United States would take out of service most of its short-range nuclear weapons and destroy many of them. Bush took this step without negotiating with the Soviet Union. But he said that the decision could be reversed if the Soviet Union did not take a similar step. The following month, the Soviet Union announced that it would do so. Also in September 1991, Bush announced that the United States would establish full diplomatic relations with the Baltic States—Estonia, Latvia, and Lithuania—and thus treat them as independent nations. These three eastern European lands had been independent from 1918 to 1940, when the Soviet Union occupied and annexed them. The United States refused to recognize the Soviet annexation. In 1990, each of the Baltic States declared its intent to restore its independence. Bush's announcement followed a failed *coup* (revolt) against Gorbachev. The coup and its failure seriously weakened the Soviet government and encouraged the Baltic States to step up their drive for independence. The Soviet Union recognized the Baltic republics' independence several days after Bush's announcement.

By the end of 1991, most of the other 12 republics that made up the Soviet Union had also declared independence, and the Soviet Union ceased to exist. Bush established full U.S. diplomatic relations with all of the former republics. He quickly sought assurance that former Soviet nuclear weapons were safely under control, that START I would be ratified, and that all arms-control agreements entered into by the Soviet Union would be followed. Four of the newly independent states—Russia, Ukraine, Kazakhstan, and Belarus—possessed long-range nuclear arms at the time of the breakup. In May 1992, their leaders and Bush signed an agreement to abide by the START I treaty. Also, Ukraine, Kazakhstan, and Belarus agreed to turn over all their strategic nuclear weapons to Russia. START I went into effect in 1994. The transfer of nuclear weapons to Russia was completed in 1996.

In June 1992, Bush and Russian President Boris Yeltsin signed an agreement to seek a formal arms-control treaty that would supplement START I. In January 1993, the two leaders signed the START II treaty. START II called for cutting the total number of U.S. and former Soviet long-range nuclear weapons to less than half the number proposed by START I. The START II cuts were to occur over a period of seven years. However, START II never went into effect due to disputes over amendments to the agreement. See **Strategic Arms Reduction Treaty.**

International trade. During Bush's administration, many people feared that the United States was losing economic power in relation to other nations, especially Japan. In January 1992, Bush traveled to Japan to meet with Japanese leaders. He wanted to lower Japanese trade barriers against U.S. products. Many Americans felt that Japan discriminated unfairly against U.S. goods and services. The president was accompanied on the trip by several prominent U.S. business leaders. But critics charged that Bush's trip accomplished little and cast

The White House

The Bush family gathered in Kennebunkport, Maine, for this portrait. The president and the first lady, *third and fourth adults from right,* are surrounded by their children and grandchildren.

the United States as a "beggar nation."

Bush's efforts to lower barriers to international trade led to the signing of the North American Free Trade Agreement (NAFTA) in December 1992. This pact called for the gradual elimination of tariffs and certain other trade barriers between the United States and Mexico and between Mexico and Canada. An agreement to gradually end similar barriers between the United States and Canada had taken effect in 1989, during Reagan's presidency. NAFTA took effect in 1994.

U.S. troops in Somalia. In December 1992, Bush ordered U.S. military forces to join other troops in Somalia. The troops were sent to protect relief groups trying to distribute food in the country. Drought and a civil war in Somalia had disrupted food production and distribution, and thousands there were starving. The U.S. forces helped end the mass starvation.

Life in the White House. The Bushes enjoyed a casual lifestyle while in the White House. They liked to entertain and often held informal parties and barbecues. The Bushes also invited heads of state and other guests to spend time at their summer home in Kennebunkport. While there, guests enjoyed rides on the president's high-speed boat and picnics on the beach. For formal While House parties, the Bushes worked on their own seating plans.

The Bushes' children and grandchildren lived in many parts of the United States but often visited the White House and the Bushes' summer home. Barbara Bush's springer spaniel, Millie, was a famous family pet.

Mrs. Bush strongly supported volunteerism. She worked to help many causes, including the reduction of AIDS and homelessness, but took a special interest in literacy programs. In 1989, Mrs. Bush helped form the Barbara Bush Foundation for Family Literacy. The organization develops programs that help families with reading problems.

The 1992 election. Bush and Quayle won renomination at the 1992 Republican National Convention in Houston. The Democrats nominated Governor Bill Clinton of Arkansas for president and Senator Al Gore of Tennessee for vice president. Texas billionaire Ross Perot and his running mate, former U.S. Navy Vice Admiral James B. Stockdale, ran as independents.

During the campaign, Bush stressed his foreign policy successes and charged that Clinton lacked experience in foreign affairs. Bush also promised to reduce federal taxes and warned that, as president, Clinton would raise taxes. Clinton, for his part, argued that Bush had failed to deal effectively with the nation's many domestic problems, including the recession and high unemployment of the early 1990's. Bush defended his record on domestic issues by claiming that the Democrat-controlled Congress had refused to enact most of his proposals. Perot accused both Bush and Clinton of not giving enough attention to such problems as the federal government's large budget deficit. In the election, Clinton defeated Bush and Perot.

Later years

Bush returned to Houston after leaving the White House. He became active with charitable organizations and helped raise several million dollars for various causes. Bush's oldest son, George W. Bush, was elected governor of Texas in 1994 and reelected in 1998. Another son, Jeb, was elected governor of Florida in 1998.

In 1997, Bush parachuted from an airplane over the desert at the U.S. Army's Yuma Proving Ground in Arizona. This jump was his first since World War II. Also in 1997, the George Bush Presidential Library and Museum opened on the campus of Texas A&M University in College Station, Texas. The library and museum includes archives, classrooms, and a conference facility. In 1999, Bush assembled a collection of his letters, *All the Best: My Life in Letters and Other Writings.*

Bush's son George W. Bush was elected president of the United States in 2000. The election marked the second time in U.S. history that the son of a former president was elected to the office. The only other father and son who both became president were John Adams, the second president of the United States, and John Quincy Adams, the fifth president.

Lee Thornton

Related articles in *World Book* include:

Bush, George Walker
Iran-contra affair
Persian Gulf War
President of the United States
Quayle, Dan
Reagan, Ronald Wilson
Republican Party
Vice President of the United States

Outline

I. Early life
- A. Boyhood
- B. War hero
- C. Bush's family
- D. College education

II. Business career
- A. Entry into the oil business
- B. Independent oilman

III. Early political career

IV. Appointive positions
- A. United Nations ambassador
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- D. CIA director

V. The 1980 election
- A. Campaign for the presidential nomination
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- B. The 1988 election

VIII. Bush's administration (1989-1993)
- A. National affairs
- B. International affairs
- C. Life in the White House
- D. The 1992 election

IX. Later years

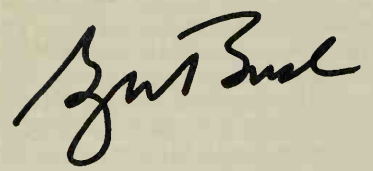
Questions

Who encouraged Bush to run for the U.S. Senate in 1970?
Who defeated Bush in the 1970 Texas election to the Senate?
What was Bush's most vital contribution to the CIA?
What were some key events in Bush's career as an oilman?
What was Bush's chief role as ambassador to the UN?
Why did Bush receive the Distinguished Flying Cross?
How did Bush deal with the attempted assassination of President Reagan in 1981?
How did the Iran-contra affair affect Bush's candidacy in 1988?
Why did Bush order U.S. troops to the Middle East in 1990?
What crisis did Bush face in the spring of 1992?

Additional resources

Duffy, Michael, and Goodgame, Dan. *Marching in Place: The Status Quo Presidency of George Bush.* Simon & Schuster, 1992.

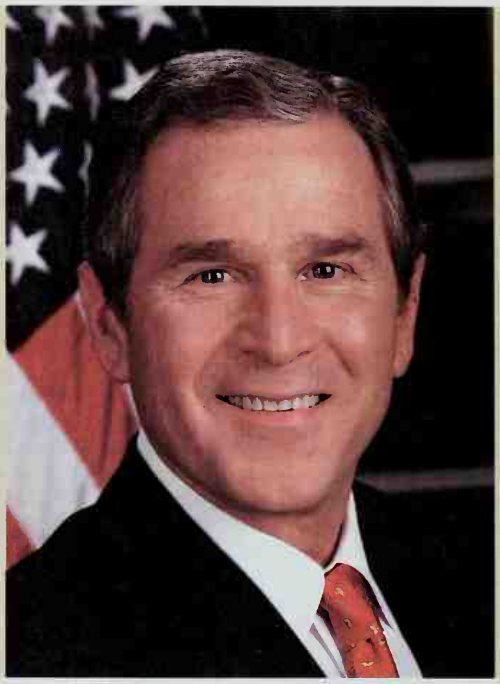
Sandak, Cass R. *The Bushes.* Crestwood Hse., 1991. Younger readers.



43rd president of the United States 2001-

Clinton
42nd president
1993-2001
Democrat

Bush
43rd president
2001-
Republican



Richard B. Cheney
Vice president
2001-

© Bob Daemmrich, Corbis/Sygma

Bush, George Walker (1946-), was elected president of the United States in 2000 in one of the closest presidential elections in U.S. history. Bush, a Republican and the governor of Texas, received a smaller number of popular votes in the election than his Democratic opponent, Vice President Al Gore. But Bush received more votes in the Electoral College. However, the outcome was in doubt for weeks after the election. It was not clear which candidate had carried Florida, where the vote was extremely close. Delays resulted from recounts of Florida ballots and court challenges to the recounts. Five weeks after the election, following a decision by the U.S. Supreme Court to halt the recounts, Gore conceded the election to Bush.

Bush's election marked the second time in U.S. history that the son of a former president was elected president. Bush's father, George Herbert Walker Bush (1924-), served as president from 1989 to 1993. The only other father and son to be elected president were John Adams and John Quincy Adams, who held office from 1797 to 1801 and from 1825 to 1829, respectively.

Bush was elected president at a time of economic prosperity and low unemployment in the United States. Many Americans recognized that not everyone shared in the prosperity, however. They were concerned with high taxes and with the growing number of homeless people. They were also alarmed by the increase in violent crimes committed by children. Many were concerned about what they saw as a decline in moral values, particularly among the country's leaders.

During his presidential campaign, Bush emphasized what he called "compassionate conservatism." He proposed to cut taxes and to use the nation's prosperity to help those in need. He pointed to his record as governor of Texas, which included reducing taxes, initiating school reform, and strengthening the state's criminal justice system.

Bush enjoys outdoor activities, especially fishing, hunting, and playing golf. He also likes country music. He wrote an autobiography, *A Charge to Keep* (1999).

Bill Minutaglio, the contributor of this article, is the author of First Son: George W. Bush and the Bush Family Dynasty.

Early life

Family background. George Walker Bush was born on July 6, 1946, in New Haven, Connecticut. His parents were living in New Haven while his father was a student at Yale University.

Bush's father, George H. W. Bush, grew up in Connecticut. After achieving financial success as an oilman in Texas, he turned to politics. His father, Prescott Sheldon Bush, had been a U.S. senator from Connecticut. George H. W. Bush served in the U.S. House of Representatives from 1967 to 1971 as a Republican from Texas. During the 1970's, he served successively as U.S. ambassador to the United Nations, U.S. envoy to China, and head of the Central Intelligence Agency. He was vice president of the United States under President Ronald

Important dates in Bush's life

1946 (July 6) Born in New Haven, Connecticut.
1968 Graduated from Yale University.
1968-1970 Served in the Texas Air National Guard.
1975 Graduated from Harvard Business School.
1977 (Nov. 5) Married Laura Welch.
1994 Elected governor of Texas.
1998 Reelected governor of Texas.
2000 Elected president of the United States.

Reagan from 1981 to 1989. He was U.S. president from 1989 to 1993.

George Walker Bush's mother, Barbara Pierce Bush (1925-), grew up in New York. Her father was the publisher of *McCall's* and *Redbook* magazines.

Barbara Pierce was 16 years old and George Herbert Walker Bush was 17 when the two met at a Christmas dance in Greenwich, Connecticut, in 1941. They married in 1945 while Bush was on leave from active duty in the U.S. Navy during World War II.

George Walker Bush was the first of the couple's six children. The second child, born in 1949, was Pauline Robinson, called Robin. She died of leukemia in 1953 at the age of 3. Young George also had three brothers—John, called Jeb (1953-), Neil (1955-), and Marvin (1956-)—and another sister, Dorothy (1959-).

Boyhood. Bush grew up in Midland, in western Texas. His parents moved to the state from Connecticut when he was 2 years old. His father wanted to get involved in the booming oil business.

Bush was 7 years old when his little sister, Robin, died. He and his parents were grief-stricken. His parents later told friends that young George helped them deal with their sorrow. George tried to be cheerful and funny and make them laugh. As a child, he was known for his love of mischief and his joking remarks.

George Bush Presidential Library

Bush as a baby is held by his parents, Barbara Pierce Bush and George H. W. Bush. George W. Bush was born in New Haven, Connecticut, where his father was a student at Yale University.

George Bush Presidential Library

As an airman in the Texas Air National Guard, Bush learned to pilot an airplane. He entered the National Guard in 1968, during the Vietnam War, after he graduated from Yale University.

School life. Bush attended Sam Houston Elementary School in Midland, then went on to San Jacinto Junior High. He spent one year, seventh grade, at San Jacinto.

In 1959, the Bushes moved to Houston. For the next two years, George attended Kinkaid School, a private academy. He was a member of the football team, and he was remembered as making friends easily.

Bush spent his final years of high school at the exclusive preparatory school his father had attended, Phillips Academy in Andover, Massachusetts. His grades were average, but his lively personality and quick tongue won him attention. He played basketball and baseball and was the head football cheerleader in his senior year.

College and military service

In 1964, Bush began his studies at Yale University, the college his father had attended. He majored in history. Classmates found him friendly and fun-loving. He enjoyed parties and sports, especially rugby, and was elected president of his fraternity, Delta Kappa Epsilon. He also belonged to Yale's elite secret society, Skull & Bones.

In 1968, as Bush was finishing up at Yale, the United States was deeply divided over the country's involvement in the Vietnam War (1957-1975). Just before college graduation, Bush applied and was accepted as an airman in the Texas Air National Guard. His commitment included 53 weeks of full-time training to become a pilot. He graduated in December 1969. He then continued flight training on the F-102 jet fighter. Bush attempted to sign up for a program that rotated pilots to Vietnam but was not accepted. He was not eligible for the program because he had not logged enough flight hours.

Business school

Bush completed his active duty with the Texas Air National Guard in 1970. He graduated from flight training school with a rank of lieutenant. In 1973, he entered Harvard Business School, where he received an M.B.A. degree in 1975.

Bush later described the three years between com-

pleting active duty and entering business school as his "nomadic" period. He continued to fulfill his part-time commitment to the National Guard, but he did not find lasting, full-time employment. During this period, he applied for admission to law school but was not accepted. He was a management trainee with an agricultural firm. He worked on a political campaign in Alabama for a Republican candidate seeking a Senate seat. He also served as a counselor in a Houston program for disadvantaged youngsters.

Congressional candidate

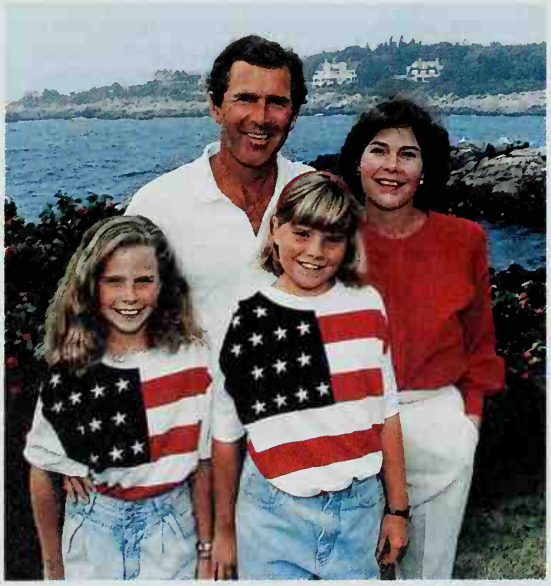
Bush returned to Midland after graduating from Harvard Business School, and he began working in the oil business. In 1977, the congressional representative for the district that included Midland announced his retirement. Bush decided to seek the Republican nomination for the post.

Bush quickly assembled a campaign team, mostly made up of friends who volunteered to help him, and began raising funds. He campaigned tirelessly across the sprawling district. He won the nomination, but he lost the election to his Democratic opponent. The opponent, a native Texan, portrayed Bush as an "outsider." However, Bush received 47 percent of the vote in a district that had never elected a Republican to Congress.

Bush's family

In mid-1977, shortly after announcing his candidacy for Congress, Bush attended a cookout at the home of friends. There, he met Laura Welch (November 4,1946-). The couple started dating, and they married about three months later, on Nov. 5, 1977. The newlyweds put off their honeymoon to focus on Bush's campaign for office.

Laura Welch Bush, a native Texan, grew up in Midland as an only child. Her father, Harold, was a building contractor, and her mother served as his bookkeeper. Laura was known as a reserved, quiet person who loved to read. She earned a bachelor's degree in education from Southern Methodist University and a master's degree in library science from the University of Texas at Austin. She was working as a librarian when she met Bush, and she had been a schoolteacher.



George Bush Presidential Library

The young Bush family lived in Midland, Texas, while Bush worked in the oil business. Bush's family includes his wife, Laura Welch Bush, and their daughters, Barbara, *left,* and Jenna.

George Bush Presidential Library

Bush's career in the oil business included forming his own oil exploration firm in the late 1970's. He merged the firm with another company in the early 1980's when petroleum prices fell.

The Bushes had twin daughters, Barbara and Jenna. The children were born in 1981 and were named for their grandmothers.

Business career

Oil exploration. In the late 1970's, Bush set up an oil exploration company, Arbusto Energy Incorporated, later called Bush Exploration Company. The company searched for potentially profitable oil and gas fields. After his election loss, Bush turned his energies to running his company.

In the early 1980's, oil prices fell, and many oil companies went out of business. Bush merged his company with another small oil firm, Spectrum 7 Energy Corporation. Bush became Spectrum's chief executive officer.

The downturn in the energy field continued, however, and Spectrum began to falter. In 1986, the struggling

firm was taken over by Harken Oil and Gas, Incorporated, later known as Harken Energy Corporation. Bush received Harken stock for his Spectrum shares and became a member of Harken's board of directors.

In the late 1980's, Bush returned to politics. His father, then vice president of the United States, was campaigning for president in the 1988 election. The younger Bush and his family moved to Washington, D.C., to help manage his father's political campaign. After the election, which his father won, Bush and his family returned to Texas and settled in Dallas.

In 1990, Bush sold most of his shares in Harken at a profit shortly before the company declared huge losses. The timing of the sale later prompted charges that Bush had known about Harken's poor financial condition. Bush said he was not aware of the firm's financial difficulties when he sold his shares. An investigation into the matter by the Securities and Exchange Commission ended in 1993 with no charges brought against Bush. By the time Bush sold his Harken shares, he had already begun a new career. He was a part owner of a baseball team.

Baseball ownership. In late 1988, Bush learned that the Texas Rangers baseball team was for sale. The American League team was based in the nearby city of Arlington. Bush and a group of investors bought the team in 1989. Bush became a managing general partner of the team. He was an enthusiastic spectator at Ranger games, and he worked to promote the team and increase attendance. Bush helped win support for a controversial plan to have a new stadium built for the team. He was involved during the planning and construction stages of the new facility, called the Ballpark in Arlington. The stadium opened in April 1994. Later that year, Bush was elected to his first political office, and he stepped down from his post with the team.

Governor of Texas

Campaign. Bush's father lost his bid for reelection as president and left the White House in 1993. That year, the younger Bush announced his candidacy for governor of Texas. At the same time, his brother Jeb was campaigning for governor of Florida.

Bush's opponent was Ann W. Richards, the state's popular governor, who was seeking a second term. During the campaign, Richards said Bush was running on his family name. Bush made no personal attacks against Richards. Instead, he criticized the governor's record, and he focused on presenting his conservative views. He supported welfare reform. He called for *autonomy* (self-government) and increased state funding for public school districts. He stressed a need for stronger criminal laws, particularly against juvenile offenders. He promised reform of the Texas civil justice system, which was clogged with unimportant lawsuits. Bush won the election by a wide margin, receiving about 54 percent of the vote. His brother lost in Florida.

First term. As governor, Bush earned high approval ratings. He worked to get legislation passed on his proposed reforms. Bush's lieutenant governor was a Democrat, and Democrats controlled both houses of the Texas Legislature. But Bush became known for achieving success with a combination of personal charm and an ability to compromise. The lawmakers enacted legislation that put limits on welfare benefits, gave local school districts more authority, imposed stricter penalties on juvenile criminals, and placed limits on civil lawsuits.

AP/Wide World

Campaigning for governor of Texas, Bush talks with supporters. He won the Texas governorship by a wide margin in 1994 and was reelected by an even wider margin in 1998.

In 1997, Bush presented a plan to restructure the Texas tax system and increase state funding for schools. At the time, Texas schools were supported by local property taxes. Bush proposed reducing property taxes and increasing the state's role in financing education. To make up for the lower property taxes, he called for an increase in the state sales tax and for a new tax on fees of doctors, lawyers, and other professionals.

Bush's proposal for new taxes received much criticism, and it was not accepted. However, the members of the Legislature did reduce property taxes by increasing the amount of a home's value that was exempt from taxes. They used surplus funds in the state budget to make up for the decreased property taxes.

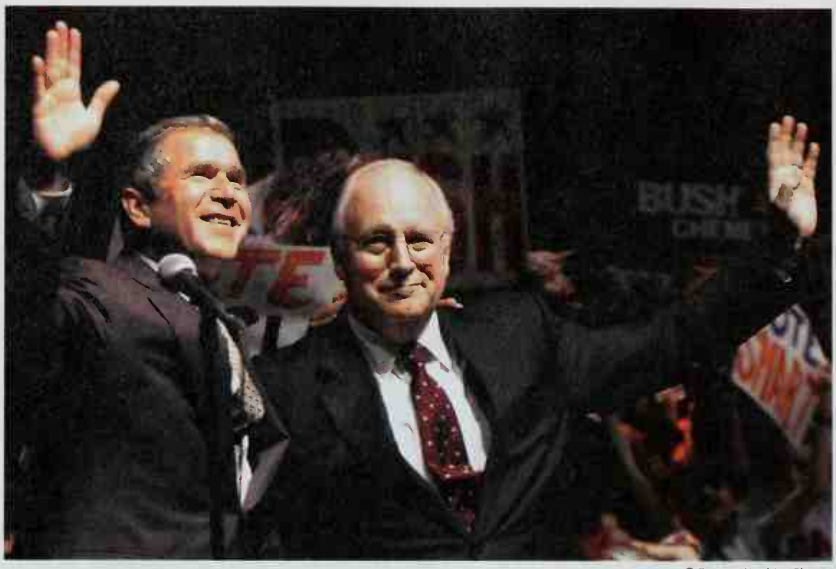
Reelection. Bush's popularity remained high throughout his term. In 1998, he ran for reelection. He defeated his opponent, Texas Land Commissioner Garry Mauro, by a wide margin. Bush received about 69 percent of the vote. He drew support not only from traditional Republicans but also from the state's Hispanic Americans, who often vote Democratic. Also in 1998, Bush's brother Jeb was elected governor of Florida.

During Bush's second term, the state increased school funding and continued to adopt educational reforms. The Legislature also approved the largest tax cuts in Texas history. Bush was criticized for not doing more to combat racism, poverty, and pollution.

Bush received national attention. Even before his second term began, he was spoken of as a possible candidate for the presidency in 2000.

Election as president

In June 1999, Bush announced that he would seek the Republican nomination for president. He faced several



© Reuters/Archive Photos

Bush and Richard B. Cheney, former U.S. secretary of defense, accept the Republican nomination for president and vice president at the Republican Party's 2000 convention in Philadelphia.

rivals, including Elizabeth Dole, former president of the American Red Cross; newspaper and magazine publisher Steve Forbes; Alan Keyes, a former State Department official; Arizona Senator John McCain, and former Vice President Dan Quayle.

The campaign. Early in Bush's presidential campaign, critics brought up events from his past. They questioned why he had been accepted in the Texas Air National Guard before others on a waiting list. They charged that Bush had gotten favorable treatment because his father was a congressman at the time. Bush said neither he nor his father had sought to influence his selection. Reporters asked Bush if he had used cocaine or other drugs in his youth, but Bush did not respond.

Senator McCain won the first of the primary elections, in New Hampshire in February 2000. By the time the March primaries ended, however, Bush had won enough delegates to secure the nomination.

At the Republican National Convention in Philadelphia in August 2000, Bush was named the Republican presidential nominee. At Bush's request, the delegates nominated Richard B. Cheney, a former congressman and U.S. secretary of defense, as their candidate for vice president. The Democrats nominated Vice President Al Gore for president and Senator Joseph I. Lieberman of Connecticut for vice president.

During the campaign, Bush labeled Gore "the candidate of the status quo." Bush emphasized what he called "compassionate conservatism." He said that the nation's prosperity must be extended to those still struggling to obtain decent living conditions. He pledged to cut taxes and to strengthen and preserve the nation's Social Security system. He stressed the need to improve the performance of the public schools and to rebuild the nation's military strength.

Gore argued that Bush lacked the experience to be president. He said Bush's proposal to use a federal budget surplus to make up for reduced taxes was risky. Gore also pointed to the danger, under Bush's plan, that the Social Security and Medicare programs would be left without sufficient funding.

The election was one of the tightest presidential contests in United States history. The outcome was in doubt for weeks after the election. It depended upon which candidate won the electoral votes of Florida, where the popular vote was very close. Florida election officials conducted a recount, and the results showed Bush ahead of Gore. But Gore asked for manual recounts in certain Florida counties. Bush challenged in court the need for those recounts. Five weeks after the election, a decision by the U.S. Supreme Court brought an end to the recounts. Gore then conceded the election, and Bush became the 43rd president of the United States.

Bush's administration

After taking office, Bush proposed legislation regarding a tax cut, education reform, and other issues that he had focused on during his presidential campaign. The Republican-controlled House passed much of this legislation, but Bush faced opposition in the Senate. The 2000 election had left the Senate evenly divided between Democrats and Republicans. However, in mid-2001, Senator James M. Jeffords of Vermont left the Republican Party to become an independent. As a result, control of the Senate shifted to the Democratic Party.

Bush and the nation faced a major crisis on Sept. 11, 2001, when the worst terrorist attack in U.S. history occurred. Terrorists in hijacked commercial airplanes crashed the planes into the two towers of the World Trade Center in New York City and into the Pentagon

Bush's election

Place of nominating convention	Philadelphia
Ballot on which nominated	1st
Democratic opponent	Al Gore
Electoral vote*	271 (Bush) to 266 (Gore)
Popular vote	50,996,039 (Gore) to 50,456,141 (Bush)
Age at inauguration	54

*For votes by states, see **Electoral College** (table).

Vice president and Cabinet

Vice president	*Richard B. Cheney
Secretary of state	*Colin L. Powell
Secretary of the treasury	Paul H. O'Neill
Secretary of defense	*Donald H. Rumsfeld
Attorney general	*John D. Ashcroft
Secretary of the interior	Gale A. Norton
Secretary of agriculture	Ann M. Veneman
Secretary of commerce	Donald L. Evans
Secretary of labor	Elaine L. Chao
Secretary of health and human services	Tommy G. Thompson
Secretary of housing and urban development	Melquiades R. Martinez
Secretary of transportation	*Norman Y. Mineta
Secretary of energy	Spencer Abraham
Secretary of education	Roderick R. Paige
Secretary of veterans affairs	Anthony J. Principi

*Has a separate biography in *World Book*

Pentagon Building near Washington, D.C. About 3,000 people died. On October 7, the United States and its allies began a military campaign in Afghanistan, the headquarters of al-Qa'ida, the terrorist organization that the U.S. government blamed for the attacks. In December, the United States and its allies helped Afghan rebels force from power the Taliban regime, which had protected al-Qa'ida. See September 11 terrorist attacks.

To improve U.S. defense against future terrorist attacks, Bush created the Office of Homeland Security. In 2002, he asked Congress to approve replacing the office with a Cabinet-level Department of Homeland Security.

International issues. In March 2001, Bush rejected the Kyoto Protocol, which calls for limiting carbon dioxide and other gases released into the atmosphere. Bush said the protocol could harm the U.S. economy by restricting the use of fuels in industrial processes. In December 2001, he announced the U.S. withdrawal from the 1972 ABM (antiballistic missile) Treaty, one of the SALT I agreements, so the country could develop an antimissile system to protect itself. In May 2002, Bush and Russian President Vladimir Putin signed a treaty to lower the number of strategic nuclear warheads in the two countries by about two-thirds over 10 years.

National affairs. The economy began to experience a slowdown by early 2001. In March 2002, Bush signed into law a bill banning unregulated "soft money" donations to national political parties. Soft money consists of unlimited contributions to political parties from corporations, unions, and individuals. In July, Bush signed a bill increasing punishments for corporate fraud. Several corporate collapses involving dishonest accounting practices had severely damaged confidence in U.S. stocks and U.S. businesses. Bill Minutaglio

See also Bush, George Herbert Walker; Bush v. Gore; Election of 2000; President of the United States; Ridge, Tom.

Outline

I. **Early life**
   A. Family background
   B. Boyhood
   C. School life
II. **College and military service**
III. **Business school**
IV. **Congressional candidate**
V. **Bush's family**
VI. **Business career**
   A. Oil exploration
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VII. **Governor of Texas**
   A. Campaign
   B. First term
   C. Reelection
VIII. **Election as president**
   A. The campaign
   B. The election
IX. **Bush's administration**
   A. International issues
   B. National affairs

Questions

How did Bush campaign against Vice President Al Gore?
What were some of Bush's achievements as governor of Texas?
Why did Bush's sale of his shares in Harken Energy Corporation draw questions?
Where did Bush do his military service during the Vietnam War?
What were the two most important industries Bush worked in before becoming governor of Texas?
Where did Bush grow up?
What did Bush mean by the phrase "compassionate conservatism"?
Before Bush, who was the only other son to follow his father as president of the United States?
What was the first political office Bush held?

Additional resources

Bush, George W. *A Charge to Keep.* Morrow, 1999.
Cohen, Daniel. *George W. Bush.* Millbrook, 2000.
Minutaglio, Bill. *First Son: George W. Bush and the Bush Family Dynasty.* Times Bks., 1999.

Bush v. Gore was a landmark ruling by the Supreme Court of the United States that played a major role in deciding the 2000 presidential election. In its decision, the court ruled that Florida could not continue to recount disputed votes in several counties and other localities without applying a consistent statewide standard.

The race between Texas Governor George W. Bush and Vice President Al Gore was one of the tightest presidential elections in U.S. history. The outcome depended on which candidate won the state of Florida, where the vote was extremely close. With Bush ahead by fewer than 1,800 votes, the candidates took their dispute to court. Eventually, the Supreme Court of Florida ordered a manual recount that would include any ballot where there was "clear indication of the intent of the voter." Bush appealed the decision to the U.S. Supreme Court.

In its majority opinion, the U.S. Supreme Court stated that the Florida court failed to establish a specific, uniform standard by which to determine the voter's intent. As a result, the existing vote-counting guidelines failed to meet "minimal constitutional standards" involving equal protection and due process of law. In addition, because there was not enough time to develop and apply a uniform standard before the Electoral College deadline, the court ruled that no further recounts could take place. Gore then conceded the election to Bush.

The court decided *Bush v. Gore* by a 5-4 vote. The majority consisted of Chief Justice William H. Rehnquist and Justices Anthony M. Kennedy, Sandra Day O'Connor, Antonin Scalia, and Clarence Thomas. Gregg Ivers

See also Election of 2000.

Bushel is the common measure of bulky articles of commerce, such as grain, in the United States. It is equal to 4 pecks, 32 U.S. dry quarts, or 2,150.42 cubic inches (35.239 liters). The United Kingdom once used a slightly smaller bushel. Richard S. Davis

See also Weights and measures.

Bushmaster is a large, poisonous snake of Central America, tropical parts of South America, and Trinidad.

WORLD BOOK illustration by Richard Lewington, The Garden Studio

The bushmaster is a large, poisonous viper. It has yellow or pale brown skin with black blotches down its back.

It may grow as long as 11 feet (3.4 meters). Like all other pit vipers, the bushmaster has a deep pit between the eye and nostril. The lining of the pit is sensitive to heat and helps the snake find warm-blooded prey. The bushmaster has a rough skin. It is yellow or pale brown with a row of large black blotches down its back. The fangs may grow 1 inch (2.5 centimeters) long. Bushmasters produce young by laying eggs. The eggs, about 10 in number, are white and larger than hens' eggs. They may be laid in the nest or burrow of a small animal. The bushmaster does not thrive in captivity because it refuses to eat. See also **Snake; Viper.** Albert F. Bennett

Scientific classification. The bushmaster belongs to the viper family, Viperidae. Its scientific name is *Lachesis muta.*

Bushmen. See San.

Business includes the activities of all commercial producers of goods and services. These producers range from small shops owned by one person to huge organizations owned by thousands of stockholders who have shares in the companies. The word *business* may refer to producers of the same product or service, such as the *clothing business* or the *insurance business.* An individual enterprise may also be called a business.

Business affects nearly every part of our lives and provides almost all the goods and services that we use daily. It also supplies most of the jobs and salaries that enable us to buy those goods and services.

The world of business includes a tremendous variety of products and services, some of which we may never see. For example, many people think of an automobile as the product of an assembly line in a plant. But the assembly line is only the final stage of a long process involving many companies. These companies include producers of batteries, glass, steel, tires, and upholstery. Manufacturing a car also requires the services of people in such professions as drafting, engineering, and tool-and-die making. Business also includes advertising, selling, and other marketing activities.

Business plays a dominant role in the United States, Canada, and other nations that have an economy based on free enterprise. In a free enterprise system, the managers of businesses decide what goods and services should be produced and what their prices should be.

This article discusses some basic principles of business, the major types of business ownership, and the operation of corporations in the United States. It also describes how the U.S. government regulates certain business activities. To learn about the structure and classification of businesses, see the *World Book* article on **Industry.** For information on various kinds of businesses, see the *Related articles* at the end of this article.

Business in a free enterprise system

Business in a free enterprise system depends on factors both in the economy and within individual companies. The most important of these factors include (1) productive resources, (2) profits, and (3) competition.

Productive resources enable business firms to produce goods and provide services. They include *natural resources*—land and raw materials, such as minerals, water, and sunlight; *capital*—a company's factories, supplies, and equipment, and its money to buy these things; *labor*—the work of a company's employees; and *technology*—a firm's scientific and business research and inventions.

The productive resources of a business are also known as *inputs.* The kind and quantity of inputs depend on the goods and services, called *outputs,* that are produced. For example, such service businesses as hotels and telephone companies need the work of many employees. Many farms require large areas of land. Many manufacturing companies must have large amounts of capital for the purchase of machinery and raw materials.

Profits are the earnings of a firm after all expenses have been paid. These expenses include the costs of productive resources in the form of wages, rent, and interest.

The goal of nearly all business firms is to earn a maximum profit. Most business policies are based on this *profit motive.* Sales provide the income for most firms, and executives try to increase their company's profit by boosting the sale of outputs to consumers. In addition, executives try to run their companies efficiently. Efficient employees and equipment help lower production costs—and thus increase profits—by getting the job done with as little waste of both energy and time as possible.

Competition among business firms affects the price and quality of goods and services. Firms must maintain reasonable prices and standards to attract and keep customers. People are not likely to buy from a company if they are dissatisfied with its product, or if they can purchase the product for less money elsewhere. Firms compete for sales by using such techniques as advertising and by offering special discounts or bonuses.

Certain types of businesses have few or no competitors. Most of these businesses provide essential services to the public. For example, many public utility companies have a legal monopoly in their fields. In providing such services as electricity and water, one company may be able to operate more efficiently than several competing firms. Other enterprises, such as airports and railroads, are too expensive for several companies to operate in the same area. In these types of businesses, government regulation replaces competition in setting prices and establishing standards of quality. See **Monopoly and competition.**

Types of business ownership

There are three main types of business ownership in

the United States: (1) single proprietorships, (2) partnerships, and (3) corporations. The nation has about 17 million single proprietorships, 2 million partnerships, and 5 million corporations.

Single proprietorships are businesses owned and operated by one person. The owner makes all decisions and receives all profits. He or she is legally responsible for any business debts. Proprietors can start a business with a small amount of capital and few legal formalities. Many single proprietorships are small stores or such service enterprises as beauty parlors and repair shops. Single proprietorships are the most common form of business ownership in farming, construction, and many other industries. Most of these businesses close down if the owner dies or runs out of capital.

Partnerships consist of two or more owners who share the responsibilities and profits of a business. In most cases, each partner is liable for all business debts.

Partners may sign a legal agreement that specifies the amount of work and capital each person contributes and the percentage of profits each receives. Most partners together can raise more capital and handle more business than a single proprietor. However, nearly all partnerships are small businesses. They are most common in law, medicine, real estate, and retailing. A partnership can be dissolved by mutual agreement or by the withdrawal of any of the partners.

Corporations are owned by stockholders, who have shares of stock in these companies. The approval of a majority of the stockholders may be required for certain major decisions that affect business operations. However, professional managers actually run the everyday activities of a corporation. Profits may be distributed among the stockholders as dividends or reinvested in the corporation. Most corporations are larger than businesses owned by individuals or partners. Corporations account for about three-fourths of all business income produced in the United States.

A corporation is more difficult to establish and operate than a single proprietorship or a partnership. For example, people who want to establish a corporation must meet many legal requirements of the federal, state, and local governments. The decisions of a corporation are also subject to the approval of both the stockholders and the managers. However, corporations have three chief advantages over other types of business ownership. First, large amounts of capital can be raised through the sale of stock. Second, the owners—that is, the stockholders—have limited liability. If the corporation goes into debt, they can lose no more than their investment. And third, business operations are not affected by an owner's death or withdrawal from the company.

Corporations vary tremendously in size and in the extent of their business activities. The firms range from small companies whose products or services reach only a few consumers to huge organizations that produce most of the goods and services in a particular field. Corporations at the two extremes of size differ so greatly that they may be considered as separate types of corporations. A third type is a *conglomerate*—that is, a giant corporation that controls many smaller companies producing different and usually unrelated goods and services.

Small corporations are generally defined as those with assets of less than $100,000. More than 2 $\frac{1}{2}$ million corporations, or about 58 percent of all U.S. corporations, are in this group. However, small corporations control less than one-half of 1 percent of the total corporate assets in the United States.

Giant corporations have assets greater than $250 million. They represent only about two-tenths of 1 percent of the corporations in the United States. But these corporations control more than 80 percent of the country's corporate assets. They dominate such industries as banking, insurance, petroleum, public utilities, and transportation. Some of their operations extend around the world. A corporation of this size controls more productive resources than many countries do.

Conglomerates own a number of companies and mostly operate in unrelated industries. Many conglomerates are formed to protect total sales from changes in the economy or in consumer demand. For example, if the member companies differ sufficiently in their activities, the conglomerate can usually offset losses in some of its operations with profits in others.

An example of a conglomerate is the General Electric Company. It makes such products as electric appliances, locomotives, jet engines, power generation equipment, automation systems, medical equipment, and plastics. The corporation has hundreds of factories, which are located in the United States and more than 20 other countries. It also operates a large financial services and leasing company and owns the National Broadcasting Company (NBC), a U.S. television network.

How a corporation operates

The way a corporation is run reflects the nature of its business and the attitudes of its management. No two business firms operate in exactly the same manner. However, nearly all corporations have a similar organization that includes (1) stockholders, (2) top management, and (3) specialized departments.

Stockholders, the owners of a corporation, vote on certain major questions of company policy and elect a board of directors to head the firm. In most cases, stockholders have one vote for each share of company stock that they own. If they cannot attend the corporation's annual meeting of stockholders, they may assign their votes to other shareholders by means of a document called a *proxy.*

Top management of a corporation consists of the board of directors and the executive officers. The board of directors determines basic company policies and appoints the executive officers. These officers include a chairman of the board or chief executive officer, a president, and a number of vice presidents. They are responsible for carrying out the decisions of the board of directors and the stockholders. The executive officers also select the managers of the various departments of the corporation.

Specialized departments. The number of departments in a corporation depends on the size of the company and on the nature of the goods and services that it provides. For example, a corporation with many employees may need a personnel department. A manufacturing firm may need a research department to study ways of developing new products or improving existing ones.

Most firms have departments that handle three basic business activities—production, finance, and marketing.

The production department has the responsibility for every activity that helps produce a firm's goods and services. In a manufacturing company, the production department may employ industrial engineers, machine operators, and a plant maintenance crew. The department may be headed by a production manager who reports to the vice president in charge of production.

The finance department handles all aspects of raising capital, making and receiving payments, and keeping financial records. It may include accountants, bookkeepers, and experts in statistics on its staff. Most finance departments are supervised by a controller.

The marketing department deals with selling goods and services to consumers. It evaluates prices, consumer demand, promotional activities, and other factors that affect sales. The department's staff may include specialists in advertising, market research, and public relations. In most corporations, the department manager reports to the vice president in charge of marketing.

Government regulation of business

In a free enterprise economy, business executives decide what products or services to offer consumers. They can adjust operating procedures and prices in an attempt to increase the profits of their firms. But in such countries as the United States and Canada, the government establishes certain controls over various business practices. These controls include (1) health and safety regulations, (2) moral regulations, and (3) antitrust laws.

Health and safety regulations are designed to ensure the welfare of a company's employees, the consumers, and the community. Some of these controls deal with working conditions. Such laws include limits on the number of hours that people work and safety standards for the maintenance of machinery.

Some health and safety regulations protect consumers. These laws range from building codes to labeling requirements for cosmetics. Other health and safety regulations involve the effects of business operations on the environment. For example, the U.S. government sets emission standards to restrict the amount of air pollution produced by automobiles.

Moral regulations. Certain business practices or products may conflict with the moral standards of a society. Its citizens may decide that these areas of business should be strictly controlled or even prohibited. Most Western nations, for example, have laws against prostitution and the sale of certain drugs. Nearly all the state governments in the United States regulate the sale of guns and alcoholic beverages.

Antitrust laws are intended to maintain competition among business firms. A trust consists of two or more companies that combine in order to control the supply and price of a product or service. Such an arrangement eliminates competition among the companies and generally results in higher prices for consumers. Other companies in the same field as a trust may find themselves forced out of business. See **Antitrust laws.**

Other regulations affect such industries as banking, air and rail transportation, and radio and television broadcasting. The government assumes additional powers over business in a national emergency or when severe economic problems occur. During World War II (1939-1945), for instance, U.S. government agencies controlled prices and rationed certain products in order to meet the nation's military needs.

Recent developments

Since the 1980's, many conglomerates and giant corporations have been formed through mergers. Mergers may be divided into two types—*hostile takeovers* and *friendly takeovers.* In a hostile takeover, an individual, group, or firm known as a *raider* acquires a sufficiently large portion of a company's stock to gain control or ownership of the company. In a friendly takeover, the shareholders and directors of two or more independent firms agree to combine their firms. Many companies have discovered that they can compete better by merging with a firm that complements their strengths.

Also in the 1990's, many businesses began *downsizing* by reducing their labor force and by spreading the former employees' work among the remaining workers. In many cases, this strategy produced short-term cost savings. But by the mid-1990's, numerous business leaders had concluded that their firms had to pay more attention to reducing error rates and improving quality.

In the late 1990's, many businesses recognized the importance of the Internet as a business tool. The Internet allows their workers to correspond effectively with clients and other businesses. It also provides them with opportunities to advertise and sell their merchandise online. Companies are also able to gather information using Internet resources to help operate their businesses more efficiently. They are also able to purchase many of their supplies online. Such online transactions are known as *electronic commerce,* or *e-commerce.*

The early 2000's were marked by a series of corporate failures related to faulty or dishonest accounting practices. In November 2001, Enron Corporation, one of the world's largest energy companies, revealed that it had overstated its earnings by several hundred million dollars since 1997. In June 2002, WorldCom Inc., a global communications company, announced that it had improperly concealed billions of dollars of expenses. Both Enron and WorldCom were based in the United States, and both filed for bankruptcy soon after their announcements. These failures led to a series of criminal investigations and charges of fraudulent accounting practices. The scandals severely damaged investors' confidence in U.S. stocks. In July 2002, Congress passed the Accounting Industry Reform Act, which established a new oversight board to monitor the accounting industry. The act also increased punishments for corporate fraud.

Richard M. Hodgetts

Related articles in *World Book* include:

Types of business ownership

Conglomerate	Holding company	Limited company
Cooperative	Joint-stock company	Partnership
Corporation		

Kinds of businesses

Agribusiness	Hotel	Multinational corporation
Agriculture	Insurance	Public utility
Bank	Mail-order business	Publishing
Chain store	Manufacturing	Restaurant
Department store	Mining	Retailing
Franchise	Motel	

Economic factors

Business cycle
Capital
Consumption
Depression
Economics
Income
Inflation
Labor force
Monopoly and competition
Price
Production
Profit
Recession
Supply and demand

American business leaders

Armour, Philip D.
Astor, John Jacob
Bendix, Vincent
Birdseye, Clarence
Boeing, William E.
Buffett, Warren
Carnegie, Andrew
Chouteau, Jean Pierre
Chouteau, Pierre, Jr.
Chrysler, Walter P.
Cochran, Jacqueline
Cooke, Jay
Cooper, Peter
Cornell, Ezra
Cudahy, Michael
Deming, W. Edwards
Dow, Herbert H.
Duke, James B.
Du Pont, Éleuthère I.
Du Pont de Nemours, Pierre S.
Durant, William C.
Eastman, George
Fargo, William G.
Field (family)
Firestone, Harvey S.
Fisk, James
Fitzsimons, Thomas
Ford, Henry
Ford, Henry, II
Gary, Elbert H.
Gates, Bill
Getty, J. Paul
Goodrich, Benjamin F.
Gould, Jay
Graham, Katharine
Gregg, John R.
Guggenheim, Meyer
Hanna, Mark
Hartford, George H.
Hershey, Milton S.
Higgins, Andrew J.
Hilton, Conrad
Hopkins, Johns
Hughes, Howard
Hunt, H. L.
Johnson, John H.
Kaiser, Henry J.
Kellogg, W. K.
Land, Edwin H.
Levitt, William J.
Lowell, Francis C.
Mackay, John William
Mellon, Andrew W.
Morgan (family)
Nash, Charles
Penney, James C.
Pullman, George M.
Rockefeller, John Davison
Sarnoff, David
Slater, Samuel
Soros, George
Sperry, Elmer A.
Stanford, Leland
Stetson, John B.
Stettinius, Edward R., Jr.
Stiegel, Henry W.
Strauss, Levi
Studebaker, Clement
Studebaker, John M.
Swift, Gustavus Franklin
Vanderbilt, Cornelius
Vassar, Matthew
Walker, Madam C. J.
Walton, Sam
Ward, Aaron M.
Watson, Thomas J.
Westinghouse, George
Wheelwright, William
Woodhull, Victoria C.
Woolworth, Frank W.

Canadian business leaders

Eaton, Timothy
Hill, James J.
McGill, James
Stephen, George
Strathcona and Mount Royal, Baron of

Other business leaders

Cunard, Sir Samuel
Krupp
Law, John
Lipton, Sir Thomas J.
Owen, Robert
Rhodes, Cecil J.
Schliemann, Heinrich
Siemens, Ernst Werner von
Siemens, Sir Charles W.
Yale, Elihu

Business organizations

Better business bureau
Business Council
Chamber of Commerce
Chamber of Commerce of the United States
Commerce, Department of
Direct Selling Association
Federal Trade Commission
Jaycees
Junior Achievement
Small Business Administration
Trade association

Other related articles

Accounting
Advertising
Antitrust laws
Bookkeeping
Capitalism
Careers (The world of work)
Commodity exchange
Conflict of interest
Credit card
E-commerce
Employee stock ownership plan
Government ownership
Government regulation
Industrial relations
Industry
Installment plan
Investment
Management information systems
Market research
Marketing
Personnel management
Privatization
Public relations
Sales
Stock, Capital
Stock exchange
Telemarketing
Trade
Unemployment

Additional resources

Cairncross, Frances. *The Company of the Future.* Harvard Business School Pr., 2002.
Figueira, Thomas J., and others. *Wisdom of the Ancients.* Perseus Pub., 2001.
Hillstrom, Kevin and Laurie C. *Encyclopedia of Small Business.* 2nd ed. Gale Group, 2002.
Kaliski, Burton S., ed. *Encyclopedia of Busine$$ and Finance.* 2 vols. Gale Group, 2001.
Oppedisano, Jeannette M. *Historical Encyclopedia of American Women Entrepreneurs.* Greenwood, 2000.
Rugman, Alan M., and Brewer, T. L., eds. *Oxford Handbook of International Business.* Oxford, 2001.

Business and Professional Women's Clubs, National Federation of, promotes equal opportunity for women in all aspects of society. It emphasizes equal treatment in the workplace and economic self-sufficiency for working women. The organization, also known as BPW/USA, has more than 120,000 members in 3,200 local groups and 53 state federations.

The organization was founded in 1919 in St. Louis, Missouri. It publishes a bimonthly magazine, *National Business Woman.* Its national headquarters are in Washington, D.C.

Critically reviewed by the National Federation of Business and Professional Women's Clubs, Inc.

Business Council is a private organization of business executives. Its members meet with government officials and other specialists to discuss economic issues and public policy and to help solve problems of national concern. The secretary of commerce organized the council in 1933 as an agency run partly by the government. It was called the Business Advisory Council until 1961, when it became a private organization. The organization's headquarters are in Washington, D.C.

Critically reviewed by the Business Council

Business cycle is the pattern of the business activity of a nation's economy. Such activity increases or decreases from time to time.

Economists have named each part of a business cycle. A period of economic growth, called an *expansion,* features high rates of buying, selling, production, and employment. A *downturn* occurs after an expansion ends and business activity starts to decrease. A period of decreased economic activity, called a *contraction,* follows a downturn. A contraction brings a decline in buying, selling, production, and employment. After a contraction comes to an end, an *upturn* takes place and leads to another expansion. The cycle then begins again.

Contractions are characterized by a decrease in consumer purchases of automobiles, television sets, appliances, and other durable goods. As a result of contractions, businesses cut their inventories of available goods. Expansions are characterized by increased pur-

chases of consumer durable goods and by increased levels of business inventories. Other factors that influence business cycles include government actions concerning taxes, spending, and monetary policy. Changes in currency exchange rates and the prices of materials sold in world markets also affect business cycles.

Changes in a nation's economic activity are not as regular as the term *cycle* suggests. For example, nine business cycles occurred from the end of World War II in 1945 to the early 2000's. They varied from 2 to 12 years and averaged almost 6 years. Irving Morrissett

See also **Recession; Inflation.**

Business law. See Law.

Busing. See Education (Current issues in U.S. education).

Bustard is the name of 22 species of game birds that live on the dry, open plains of Europe, Asia, Australia, and, especially, Africa. Bustards vary in size between the length and weight of a chicken and that of a large turkey. The great bustard, which ranges from southern Europe

WORLD BOOK illustration by John F. Eggert

The great bustard inhabits plains of Europe and Asia.

to China, is one of the heaviest of all flying birds. It may weigh as much as 46 pounds (21 kilograms).

Males of some species of bustards perform remarkable displays to attract females. During these displays, the males swell up their necks, raise their feathers, and twist their bodies into odd postures. Bustards feed on insects and plants. The ranges of most bustards have been reduced by the spread of human settlement and by hunting, and the survival of several species is threatened. Peter G. Connors

Scientific classification. Bustards form the bustard family, Otidae. The scientific name for the great bustard is *Otis tarda.*

Bustle. See Clothing (The 1600's).

Butane and propane, *BYOO tayn, PROH payn,* are colorless, flammable gases. They are found in natural gas, light crude oil, and gases that are formed when heavy oil is *cracked* (broken down chemically) to produce gasoline.

Both butane and propane liquefy readily under pressure at ordinary temperatures. Mixtures of liquefied butane and propane are called *LPG* (liquefied petroleum gas). These mixtures, which are usually composed primarily of propane, are used as fuel in industry, trucks, and homes in isolated areas. Butanes are also added to gasoline to increase its *volatility* (evaporation rate) in cold climates. *Isobutane,* a form of butane, is used to make high-octane gasolines. Propane is an important source of *ethylene,* a colorless, flammable gas.

Propane boils at −43.7 °F (−42.1 °C). Normal butane boils at 31.1 °F (−0.5 °C), and isobutane boils at 10.9 °F (−11.7 °C). Propane has the chemical formula C_3H_8. Butane has the chemical formula C_4H_{10}. Geoffrey E. Dolbear

See also **Gas** (Gas in the home).

Butcher. See Meat packing.

Butcherbird. See Shrike.

Butler, Benjamin Franklin (1818-1893), was an American politician and a Union general during the Civil War (1861-1865). Shortly after the war broke out, Butler entered the Union Army as a brigadier general of the Massachusetts militia. In May 1861, he occupied Baltimore and kept it in Union hands. That same month, Butler was promoted to major general of volunteers and given command of the Department of Eastern Virginia. In 1862, while in charge of Union troops occupying New Orleans, he became known as "Beast Butler" among city residents who opposed his authority. In 1863, Butler became commander of the Department of Virginia and North Carolina. In 1864, he took command of the Army of the James.

After the war, Butler represented Massachusetts in the U.S. House of Representatives from 1867 to 1875 and from 1877 to 1879. He became a leading Republican in the House and demanded firm treatment of the South. He was a major opponent of President Andrew Johnson in Johnson's impeachment trial.

Butler was born on Nov. 5, 1818, in Deerfield, New Hampshire. He served in the Massachusetts house of representatives in 1853 and in the state senate in 1859. In 1882, he successfully ran as the Democratic Party's candidate for governor of Massachusetts. He served as governor in 1883 and 1884. Butler was the Anti-Monopoly and Greenback parties' candidate for president in 1884. Michael Perman

Butler, Nicholas Murray (1862-1947), served as president of Columbia University from 1902 to 1945 and founded Teachers College, Columbia University. Butler also helped found the Carnegie Endowment for International Peace. He shared the 1931 Nobel Peace Prize with Jane Addams.

Butler was born April 2, 1862, in Elizabeth, New Jersey. He earned a bachelor's degree, a master's degree, and a doctor's degree from Columbia before studying in Berlin and Paris. Butler also served as a delegate to 14 Republican national conventions. Glenn Smith

Butler, Pierce (1744-1822), a planter and statesman, was a South Carolina signer of the Constitution of the United States. During the Constitutional Convention of 1787, Butler favored a strong central government as long as it was limited by checks and balances among its branches. He was not entirely satisfied with the Constitution, but he believed it would create the kind of government needed to strengthen the nation.

Butler was born in County Carlow, Ireland. His father, Richard Butler, was a member of the Irish Parliament. Pierce Butler first came to South Carolina during the 1760's as a major in the British Army. In 1771, he married Mary Middleton, a member of a wealthy South Carolina

family. Soon afterward, he resigned from the army to become a planter.

Butler served several terms in the South Carolina legislature from 1776 to 1779. He was a member of the Congress of the Confederation in 1787. Butler served in the U.S. Senate from 1789 to 1796 and in 1803 and 1804. He also served briefly as director of the Bank of the United States. Robert M. Weir

Butler, Samuel (1613-1680), was an English poet and satirist. He is best known for his long verse mock romance, *Hudibras* (part I, 1663; part II, 1664; part III, 1678). Butler based the work on *Don Quixote,* a satiric novel written by the Spanish author Miguel de Cervantes. The characters in *Hudibras* include familiar figures of Butler's day as well as historical figures. Butler especially ridiculed the hypocrisy and intolerance he saw among Puritan religious groups. But the poem is also more broadly concerned with human nature and human failings. Butler's other important writings were collected in *The Genuine Remains in Verse and Prose* (published in 1759, after the author's death). The collection includes a set of satires called "Characters" and another satire called "The Elephant in the Moon."

Detail of oil portrait by Jacob Huysman, National Portrait Gallery, London

Samuel Butler

Butler was born on a farm in what is now the county of Hereford and Worcester. Little is known about Butler before he gained fame with the publication of *Hudibras.* Steven N. Zwicker

Butler, Samuel (1835-1902), an English author, is best known for the satirical novel *Erewhon* (1872). Like Jonathan Swift's *Gulliver's Travels, Erewhon* ridicules English institutions and customs through the eyes of a traveler in a strange new world. But *Erewhon* has a tone of cool amusement, unlike the tone of bitter scorn in *Gulliver's Travels.*

Butler's other major work is *The Way of All Flesh* (published in 1903, after his death). It is a realistic, autobiographical novel that presents a detailed picture of Victorian society. The book contains much wit and some likable characters, but is generally bitter in tone. The bitter tone reflects in part Butler's own cheerless childhood, which his father dominated. Butler also wrote other satirical works, travel books, and essays that attacked various aspects of Charles Darwin's theories of evolution.

Butler was born in Langar rectory, Nottingham. He was the son of a clergyman. Frank W. Wadsworth

Butler, William Orlando (1791-1880), was the Democratic candidate for vice president of the United States in 1848. He and presidential candidate Lewis Cass were defeated by Whig candidates Zachary Taylor and Millard Fillmore. Butler, who won military honors for service in the War of 1812 and the Mexican War, was a member of the U.S. House of Representatives from Kentucky from 1839 to 1843. He was born in Jessamine County, Kentucky. Michael F. Holt

Artstreet

Buttes rise abruptly above the surrounding countryside. They are found chiefly in the Western United States. This photograph shows "The Mittens," two buttes in southeastern Utah.

Butte, *byoot,* is a steep-sided hill or small mountain that stands alone, rising sharply above the surrounding countryside. The word *butte* is a French word meaning *mound.* Buttes are chiefly found in the dry, Western part of the United States. In most cases, they are capped by horizontal layers of hard rock that protect underlying beds of less resistant rock from erosion. Buttes resemble flat-topped plateaus called *mesas* in the way they form (see Mesa). But they are smaller than mesas and have more uniform dimensions. M. Dane Picard

Butte, *byoot,* Montana (pop. 34,606), is called *The Mile High City* and *The City That's a Mile High and a Mile Deep.* It lies on a plateau in southwestern Montana, 5,765 feet (1,757 meters) above sea level. Some mine shafts once reached as far as 5,000 feet (1,500 meters) below the earth's surface. Thousands of mine tunnels run beneath the streets of Butte and extend into the side of the hill on which the city is built. Butte is one of the largest cities in Montana. It is about 65 miles (105 kilometers) southwest of Helena, the state capital (see Montana [political map]).

Butte is the center of a rich mining district. The mines produce copper, gold, and silver, and their by-products arsenic, cadmium, and molybdenum. Butte is the home of Montana Tech of the University of Montana.

For many years, copper mining was Butte's chief industry. But only some copper is mined today. The Berkeley Pit, once the site of open-pit mining operations, is filled with toxic water.

Placer mining for gold began in the area in 1864. The townsite was laid out in 1867 and named for a prominent butte nearby. Quartz mining for silver and copper developed in the late 1800's. Open-pit mining began in 1953. In 1983, the copper mining company closed the mines because they had become unprofitable and allowed the tunnels and the Berkeley Pit to fill with water. In 1986, some copper mining resumed in the area.

In 1977, Butte combined its government with that of Silver Bow County. Butte is the seat of Butte-Silver Bow County and is governed by a board of county commissioners. For the monthly weather in Butte, see Montana (Climate). Harry W. Fritz

Butter is a tasty spread for bread. People also fry foods in butter and use it as a part of many baked foods. Butter

consists chiefly of *butterfat,* a fat that comes from milk and cream.

In the United States, people use butter made from the milk of cows. In some countries, however, butter may be made from the milk of goats, horses, reindeer, sheep, or other animals. Several products are made from butter. These products include *butter oil* and *whipped butter.* Butter oil is a liquid used in cooking. Whipped butter has air mixed in it to make it lighter and easier to spread.

Throughout history, people have used butter for various purposes other than for food. In ancient Rome, for example, people used butter as a hairdressing and also as a skin cream.

How butter is made

Butter comes from butterfat, which is present in milk and cream in the form of tiny droplets. Butter is churned from cream because cream contains about 10 times as much butterfat as milk does. When cream is mixed rapidly at a certain temperature, droplets of butterfat form particles called *butter granules.* Churning turns these particles into butter. Creameries make butter in a process that has three steps: (1) pasteurization, (2) churning, and (3) packaging.

Pasteurization. Cream must be pasteurized before churning. Pasteurization kills harmful bacteria and prevents butter from spoiling. There are two types of pasteurization, *batch pasteurization* and *high-temperature short-time pasteurization.* In batch pasteurization, the cream must be heated to at least 165 °F (74 °C), and held at this temperature for at least 30 minutes. In the high-temperature short-time process, the temperature must reach 185 °F (85 °C) for at least 15 seconds.

Churning involves beating or stirring cream to turn butterfat into butter. Before churning, cream must be kept in storage tanks at 40 °F to 50 °F (4 °C to 10 °C) for several hours. During storage, a process called *tempering* occurs, which makes cream easier to churn.

Creameries make two chief kinds of butter, *sweet cream butter* and *sour cream butter.* Most butter made in the United States is the sweet cream type. Sweet cream butter is made from *sweet* (fresh) cream. Sour cream butter is made from cream that has been soured. A creamery may *ripen* (sour) cream by adding lactic acid bacteria to it. Ripening improves the flavor of butter and helps preserve its freshness. Salt may be added to help preserve either sweet cream or sour cream butter.

During churning, creameries sometimes color butter with various food dyes. The natural color of butter varies from pale to deep yellow, depending on the breed of cow and the feed it ate. A feed consisting of fresh green grass makes butter a deeper yellow than does a feed made up of grain or hay.

There are two methods of churning cream into butter. These methods are *continuous churning* and *conventional churning.*

Continuous churning is done by large machines that make butter by rapidly beating cream. The beating process causes the formation of a mixture of butter granules and a milky liquid called *buttermilk* (see **Buttermilk**). This mixture passes through a tube-shaped device that looks like a cannon. There, the buttermilk drains off, and the butter is left behind. Continuous churns can turn cream into butter in three minutes or less. They make smoother and more evenly colored butter than do conventional churns. Continuous churns also cost less to operate.

Continuous churns produce most of the butter made in the United States. They turn out a steady flow of butter, rather than only a certain amount at a time, as do conventional churns. Continuous churning results in a more uniform product.

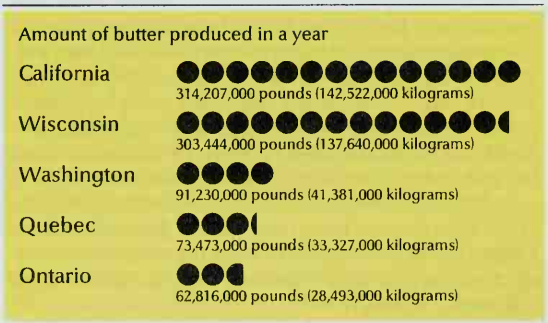
Conventional churning takes place in large stainless steel drums. Each drum is filled from a third to half of its capacity with cream and is then rotated for about 30 to 45 minutes. Butter granules and buttermilk form after that time. The buttermilk is drained away, and the butter granules are rinsed in cold water. Then most of the water is drained off, and salt may be added. The drum continues to rotate until the butter granules, the remaining water, and the salt have all blended. A conventional churn can produce as much as 8,500 pounds (3,860 kilograms) of butter at a time.

Packaging. Machines cut the butter into rectangular blocks called *prints.* Prints weigh $\frac{1}{4}$, $\frac{1}{2}$, or 1 pound (0.1, 0.2, or 0.5 kilogram). The same machines then wrap the prints in waxed paper and put them into packages for sale. Butter may also be packed in 68-pound (31-kilogram) cubes for storage or for wholesale use.

Composition and food value

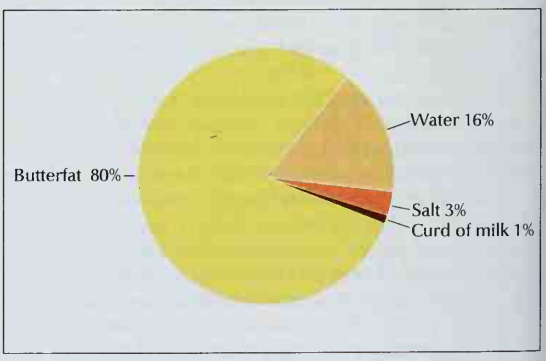
Butter gets its food value primarily from the butterfat it contains. Standards set by the United States Depart-

Leading butter-producing states and provinces



Figures are for 1997.
Sources: U. S. Department of Agriculture; Statistics Canada.

Typical composition of butter



ment of Agriculture require that butter consist of at least 80 percent butterfat. Most butter averages about 80.5 percent butterfat. Butter contains cholesterol, a fatty substance that makes up a part of all animal tissue. See Cholesterol.

The Agriculture Department sets standards for grading butter based on color, flavor, texture, and other qualities. The best butter has the rating *U.S. Grade AA.* Butter has about 3,240 calories per pound (7,143 calories per kilogram) and ranks as a good source of energy and Vitamin A. Lightly salted butter has only a tiny amount of salt, and unsalted butter contains no salt.

History

Historians do not know when people first made butter. People in India churned butter from the milk of water buffaloes as early as 2000 B.C. Until the development of commercial creameries, people used many kinds of clay or wooden churns to make butter. Some churns had a device called a *dasher* to stir the cream.

The first creamery to make large quantities of butter by machine opened in Orange County, New York, in 1856. In 1879, Carl Gustaf de Laval, a Swedish engineer, patented a device called the *centrifugal separator* for removing cream from milk. His invention greatly increased butter production. The first continuous churn began to make butter in 1937 in Australia.

The use of butter in the United States reached its highest level during the 1920's and 1930's. Thereafter, the increasing popularity of margarine reduced the sale of butter. Margarine tastes like butter, has the same food value, and usually costs less. Margarine also contains less cholesterol.

In the 1980's, *butter-margarine blended products* were introduced. These products are less expensive and have a smaller amount of cholesterol than butter, but they are more flavorful than margarine. Today, people in the United States consume, on the average, 4 pounds (2.0 kilograms) of butter per person annually.

Michael F. Hutjens

See also **Churn; Margarine.**

Butter-and-eggs. See Toadflax.

Buttercup, also called *crowfoot,* is a bright yellow wild flower found in most parts of the Temperate zones. The name *buttercup* comes from the color of the cup-shaped flowers. They usually have five rounded petals with a gleaming, satiny surface. *Crowfoot,* the other common name of this plant, describes the leaves. The leaves usually are deeply divided into three main parts and look somewhat like the feet of birds.

The *common buttercup* grows 1 to 4 feet (30 to 120 centimeters) tall. It is found mostly in fields and woods, and along roadsides. The *creeping buttercup* has stems that run along the ground and may spread over a wide area. Most buttercups grow best in damp places, especially the *swamp buttercup.* Other kinds of buttercups include the *yellow water buttercup* and *grassy buttercup.* Well-known plants in the buttercup family include anemone, columbine, hepatica, and larkspur.

Spring is the season when the wild buttercups bloom in greatest numbers. Their flowers also appear throughout the summer until September. Farmers regard buttercups as troublesome weeds. Cattle will not eat the plants because of their bitter, burning juice. Buttercups often become the dominant plant life in an area because they can grow and reproduce more successfully than many other types of plants. Melinda F. Denton

WORLD BOOK illustration by Christabel King

Creeping buttercups have stems that spread along the ground and send down roots that grow into new plants.

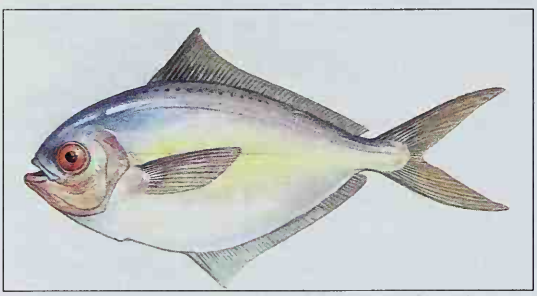
Scientific classification. The buttercup belongs to the crowfoot family, Ranunculaceae. The scientific name for the common buttercup is *Ranunculus acris.* The creeping buttercup is *R. repens;* the swamp buttercup, *R. septentrionalis;* the yellow water buttercup, *R. flabellaris;* and the grassy buttercup, *R. gramineus.*

See also **Aconite; Fennel; Hellebore.**

Butterfish is a type of small, silvery-blue ocean fish shaped like a long serving plate with fins. Butterfish have a distinctive row of pores along the top part of the body. Most butterfish measure 7 to 8 inches (18 to 20 centimeters) long. The young often take shelter under jellyfish. Groups of 10 to 15 young butterfish have been found swimming among the tentacles of a single jellyfish.

Butterfish are found along the Atlantic coast of North America from Nova Scotia to the Gulf of Mexico. They spend the winter far offshore in deep waters. In spring and summer, they migrate close to shore in schools. They are excellent food fish. Tomio Iwamoto

Scientific classification. Butterfish belong to the butterfish family, Stromateidae. The scientific name for the most common type is *Peprilus triacanthus.*



WORLD BOOK illustration by John F. Eggert

A butterfish is an excellent food fish.

© Edward S. Ross

A copper butterfly stops at a flower and sucks up nectar with its long, tubelike *proboscis.* Most adult butterflies feed only on nectar. The proboscis coils up when not in use.

Butterfly

Butterfly is one of the most beautiful of all insects. People have always been charmed by the delicate, gorgeously colored wings of butterflies. The beauty and grace of these insects have inspired artists and poets. Butterflies have also played a part in religious beliefs. The ancient Greeks believed that the soul left the body after death in the form of a butterfly. Their symbol for the soul was a butterfly-winged girl named Psyche.

Butterflies live almost everywhere in the world. Tropical rain forests have the most kinds of butterflies. Other kinds of butterflies live in woodlands, fields, and prairies. Some butterflies live on cold mountaintops, and others live in hot deserts. Many butterflies travel great distances to spend the winter in a warm climate.

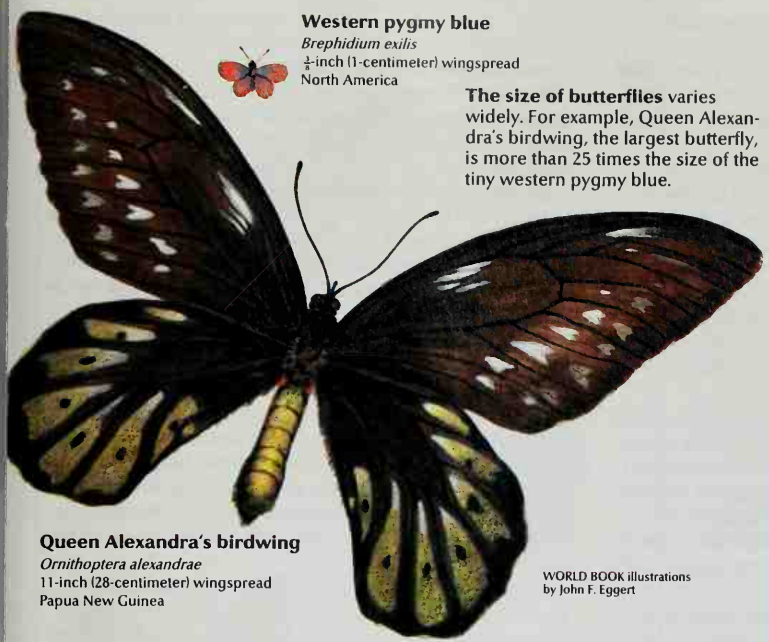
There are about 15,000 to 20,000 *species* (kinds) of butterflies. The largest butterfly, Queen Alexandra's birdwing of Papua New Guinea, has a wingspread of about 11 inches (28 centimeters). One of the smallest butterflies is the western pygmy blue of North America. It has a wingspread of about $\frac{3}{8}$ inch (1 centimeter). Butterflies are every color imaginable. The colors may be bright, pale, or shimmering and arranged in fantastic patterns. The word *butterfly* comes from the Old English word *buterfleoge,* meaning *butter* and *flying creature. Buter* probably referred to the butter-yellow color of some European butterflies.

Butterflies and moths together make up an insect group called Lepidoptera. The name comes from two Greek words: *lepis,* which means *scale;* and *pteron,* which means *wing.* The name refers to the powdery scales that cover the two pairs of wings of both butterflies and moths. However, butterflies differ from moths in a number of important ways, including the following four. (1) Most butterflies fly during the day. The majority

Lee D. Miller, the contributor of this article, is Curator of the Allyn Museum of Entomology/Florida Museum of Natural History.

Western pygmy blue
Brephidium exilis
$\frac{1}{2}$-inch (1-centimeter) wingspread
North America

The size of butterflies varies widely. For example, Queen Alexandra's birdwing, the largest butterfly, is more than 25 times the size of the tiny western pygmy blue.



Queen Alexandra's birdwing
Ornithoptera alexandrae
11-inch (28-centimeter) wingspread
Papua New Guinea

WORLD BOOK illustrations by John F. Eggert

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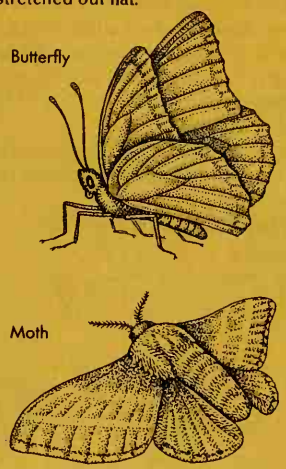
A caterpillar feeds on plants until it reaches full size, *above*. It then forms a shell, inside which the wormlike caterpillar develops into a beautiful butterfly.

How butterflies differ from moths

Butterflies and moths together make up the insect group Lepidoptera. But butterflies differ from moths in a number of ways. (1) Most butterflies fly during the daytime. Most moths fly at night. (2) The majority of butterflies have knobs at the ends of their antennae. The antennae of most moths are not knobbed. (3) Most butterflies have slender, hairless bodies. Most moths have plump, furry bodies. (4) Most butterflies rest with their wings upright over their bodies. Most moths rest with their wings stretched out flat.



WORLD BOOK illustrations by Patricia Wynne

of moths, on the other hand, fly at dusk or at night. (2) Most butterflies have knobs at the ends of their antennae. The antennae of most moths are not knobbed. (3) Most butterflies have slender, hairless bodies. The majority of moths have plump, furry bodies. (4) Most butterflies rest with their wings held upright over their bodies. Most moths rest with their wings spread out flat.

A butterfly begins its life as a tiny egg, which hatches into a caterpillar. The caterpillar spends most of its time eating and growing. But its skin does not grow, and so the caterpillar sheds it and grows a larger one. It repeats this process several times. After the caterpillar reaches its full size, it forms a protective shell. Inside the shell, an amazing change occurs—the wormlike caterpillar becomes a beautiful butterfly. The shell then breaks open, and the adult butterfly comes out. The insect expands its wings and soon flies off to find a mate and produce another generation of butterflies.

Butterfly caterpillars have chewing mouthparts, which they use to eat leaves and other plant parts. Some kinds of caterpillars are pests because they damage crops. One of the worst pests is the caterpillar of the cabbage butterfly. It feeds on cabbage, cauliflower, and related plants.

Adult butterflies may have sucking mouthparts. The adults feed mainly on nectar and do no harm. In fact, they help pollinate flowers. Many flowers must have pollen from other blossoms of the same kind of flower to produce fruit and seeds. When a butterfly stops at a flower to drink nectar, grains of pollen cling to its body. Some of the pollen grains rub off on the next blossom the butterfly visits.

Kinds of butterflies

Scientists group the thousands of species of butterflies into families, according to various physical features the insects have in common. The chief families include (1) skippers; (2) blues, coppers, and hairstreaks; (3) brush-footed butterflies; (4) sulphurs and whites; (5) metalmarks; (6) satyrs and wood nymphs; (7) swallowtails; (8) milkweed butterflies; and (9) snout butterflies. Each of these families has species in North America.

Skippers differ from all other kinds of butterflies in two major ways, and so scientists classify them sepa-

rately from *true butterflies.* (1) Skippers have plump bodies and therefore look more like moths than butterflies. (2) Their antennae have hooked tips, unlike the rounded tips on the antennae of true butterflies.

There are about 3,500 kinds of skippers. Various species live in all parts of the world, except for the extreme polar regions. Skippers get their name from the way they swiftly skip and dart while flying. They range in color from orangish-brown to dark brown and in many cases have white and yellow markings. Nearly 300 species of skippers can be found in North America. They include the silver-spotted skipper, the roadside skipper, the fiery skipper, the checkered skipper, Juvenal's duskywing, and the least skipperling.

Blues, coppers, and hairstreaks account for almost 4,000 species worldwide, and they live in almost every type of environment. They are small butterflies whose names describe their appearance. Blues have a brilliant blue or violet color. Coppers are a fiery orange-red. Most species of hairstreaks have a hairlike "tail" on each of their hind wings. A number of blues and coppers also have such "tails."

About 150 kinds of blues, coppers, and hairstreaks live in North America. They include the spring azure, the bronze copper, and the great purple hairstreak. The caterpillars of some species produce a sweet liquid known as *honeydew.* Certain ants "milk" the honeydew from the caterpillars and also protect the caterpillars from enemies.

Brush-footed butterflies total about 3,500 species. Members of this family live everywhere in the world, except for ice-covered polar regions and the driest deserts. These butterflies have short front legs, called *brush feet,* which contain special organs that help the insects locate food. Most species of brush-footed butterflies have bright colors on the upper wing surface and dark colors on the undersurface. When a brush-footed butterfly closes its wings, the dark undersurface helps the insect blend with its surroundings.

About 150 kinds of brush-footed butterflies live in North America. They include such small butterflies as crescents and checkerspots and such large ones as fritillaries. Some of the best-known butterflies—the viceroy, the red admiral, and the mourning cloak—belong to this family.

Sulfurs and whites form a family of about 1,000 species. They can be found throughout the world, but most of them live in tropical regions. At least 60 species

Butterflies of the world

Skippers

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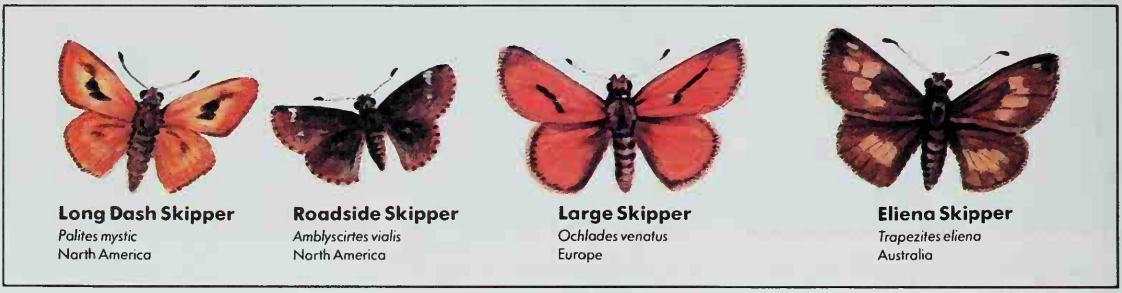


Long Dash Skipper
Polites mystic
North America

Roadside Skipper
Amblyscirtes vialis
North America

Large Skipper
Ochlades venatus
Europe

Eliena Skipper
Trapezites eliena
Australia

Blues, coppers, and hairstreaks

Great Purple Hairstreak
Atlides halesus
North America

Silvery Blue
Glaucopsyche lygdamus
North America

Common Oakblue
Narathura micale amphis
Australia

American Copper
Lycaena phlaeas
North America

Lycaena arus
Africa

Adonis Blue
Lysandra bellargus
Europe

Painted Lady
Vanessa cardui
North America and Europe

Red Admiral
Vanessa atalanta
North America and Europe

Marpesia marcella
South America

Cabbage White
Artogeia rapae
North America and Europe

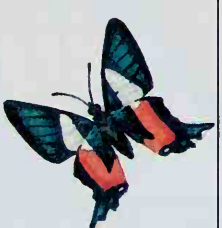
Orange Sulfur
Colias eurytheme
North America

Northern Jezabel
Delias argenthona argenthana
Australia

Sara Orangetip
Anthocharis sara
North America

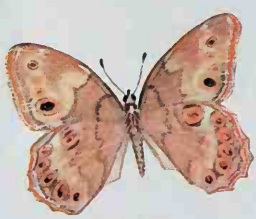
Metalmarks

Little Metalmark
Calephelis virginiensis
North America



Ancyluris formosissima
South America

Satyrs and wood nymphs



Pearly Eye
Enodia portlandia
North America

Caenonympha dorus
Europe

Tisiphone abeona morrisi
Australia

of sulfurs and whites live in North America. Sulfurs range in color from light yellow to orange and are named after the powdery yellow mineral. The wings of most sulfurs have black edges. One species, the southern dogface, has markings that suggest the face of a dog. In orange-tip butterflies, the tips of the front wings have brilliant orange coloring.

Whites have white wings that may be marked with black, brown, yellow, or red spots. The most common white is the cabbage butterfly. The caterpillar of this butterfly is a major pest.

Metalmarks form a family of about 1,000 species. These butterflies live throughout the world but are especially common in South America. Their name comes from metallic-looking marks on the wings of most species. Tropical metalmarks are of almost every combination of colors and patterns imaginable. Fewer than 25 species of metalmarks live in North America. Most of them, including the northern metalmark and the little metalmark, range in color from dull reddish-brown to dark brown.

Satyrs and wood nymphs total about 800 species. Most kinds live in the tropics. However, a few species are found in high mountainous regions and the Arctic. Satyrs and wood nymphs have short front legs and fly close to the ground. Most have brown wings dotted with *eyespots* (markings that look like eyes).

More than 50 species of satyrs and wood nymphs live in North America. The names of several of these species, including the pearly eye and the eyed brown, refer to their beautiful eyespots.

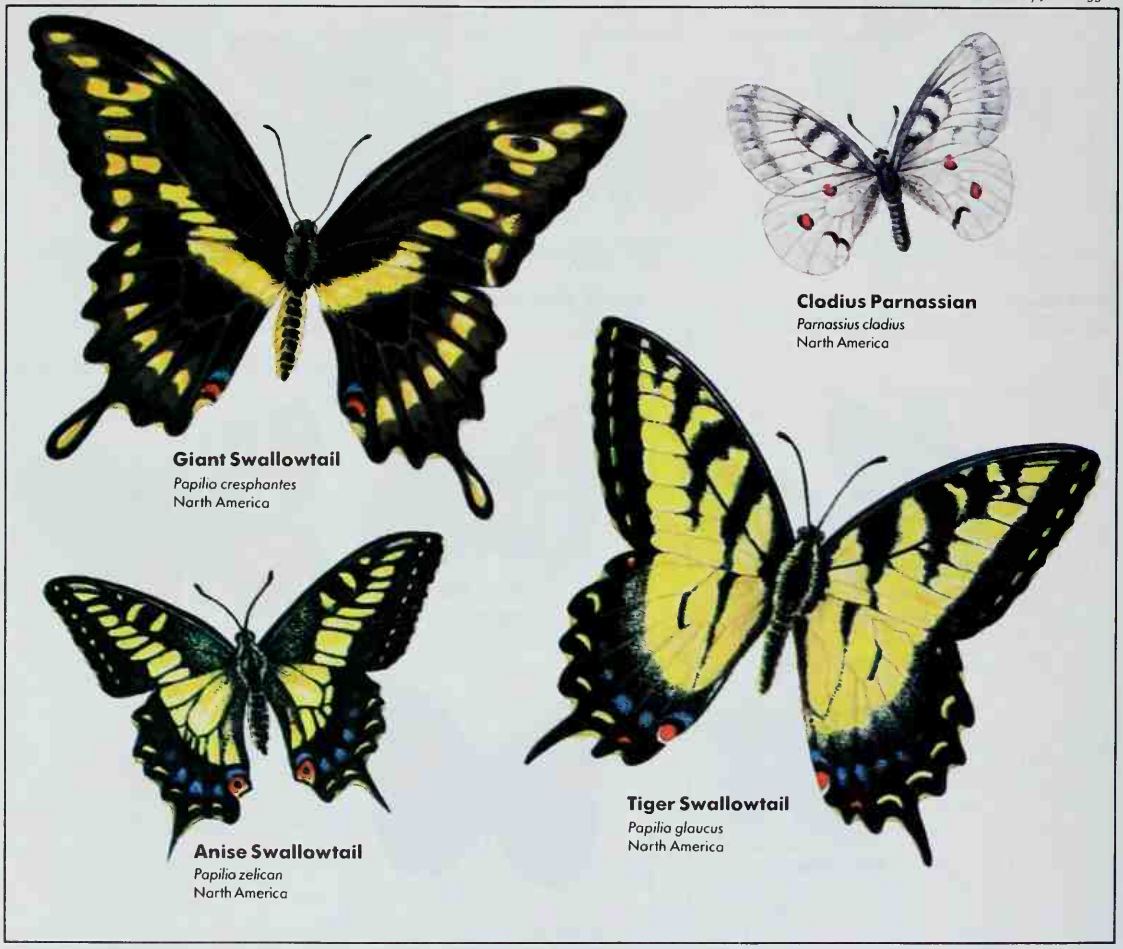
Swallowtails account for about 600 species of butterflies. They are a worldwide family, though most species are found in the tropics. Swallowtails are among the largest and most beautiful butterflies. They include Queen Alexandra's birdwing, the largest of all butterflies, and the African giant swallowtail, which has a wingspan of up to 10 inches (25 centimeters). Most swallowtails have a long extension on each hind wing. The butterflies get their name from these extensions, which resemble the tails of certain swallows.

Most swallowtails are black, brown, and yellow with red and blue spots on their hind wings. One group, the parnassians, has white or creamy wings with red and black spots. Parnassians do not have "tails."

About 35 species of swallowtails live in North America. They include the black swallowtail, the tiger swallowtail, and the zebra swallowtail.

Swallowtails

WORLD BOOK illustrations by John F. Eggert



Papilio dardanus
Africa

Papilio memnon
Asia

Ulysses or
Mountain Blue
Papilia ulysses joesa
Australia

Common Swallowtail
Papilio machaon
Europe

Milkweed butterflies

Monarch
Danaus plexippus
North America

Lycorea ceres
South America

Common Australian Crow
Euplaea care corinna
Australia

Snout butterflies

Southern Snout
Libytheono carinenta
North America

Australian Beak
Libythea geoffroy genia
Australia

Milkweed butterflies total about 200 species worldwide. They are large, slow-flying butterflies with very short front legs. Most of these butterflies range in color from orange to brown. Their wings have black veins and black margins with white spots. Some species that live in Africa and Asia are blue, violet, or white, with brown markings. The caterpillars of this family feed on milkweed plants.

Only four species of milkweed butterflies live in North America. And only two of these species are common. They are the monarch butterflies, famous for their long flights south each fall, and the queen butterflies, which do not make such journeys.

Snout butterflies form a small family of 17 species, most of which live in the tropics. The butterflies get their name from their long, beaklike mouthparts. Only two species, the snout butterfly and the southern snout butterfly, live in North America. Both have brown wings with orange and white markings.

The bodies of butterflies

Butterflies have certain body features in common with other insects. For example, a butterfly has a hard, shell-like skin called an *exoskeleton* (outer skeleton). The exoskeleton supports the body and protects the internal organs. A butterfly's body, also like that of any other insect, has three main parts: (1) the head, (2) the thorax, and (3) the abdomen.

The head is the center of sensation. It bears a butterfly's (1) eyes, (2) antennae, and (3) mouthparts.

Eyes. On each side of its head, a butterfly has a large *compound eye,* which consists of thousands of tiny lenses. Each lens provides the insect with an image of part of its surroundings. The brain combines the separate images into a complete view.

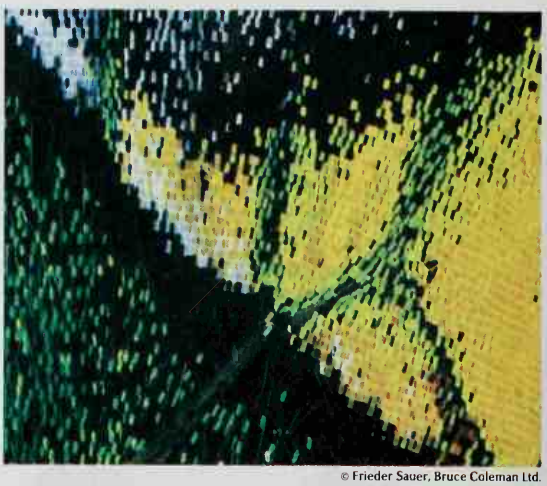
Antennae. Two long, slender antennae grow between the eyes. The antennae are organs of smell. A butterfly uses its sense of smell to locate food and to find mates. The antennae probably also serve as hearing and touch organs.

Mouthparts. A butterfly caterpillar has chewing mouthparts that consist of two lips and two pairs of jaws. These structures re-form as the caterpillar changes into an adult butterfly. One pair of jaws nearly disappears. The other pair becomes a long sucking tube, called a *proboscis,* that coils up when not in use. The lips form a sheath for the proboscis.

A butterfly uses its proboscis to suck nectar and other liquids. Muscles in the head help the insect draw fluid up the proboscis and into a cavity in the head. A covering on the end of the proboscis closes and keeps fluid from flowing out. Other muscles force the fluid into the stomach.

The thorax forms the middle section of a butterfly's body. A short, thin neck connects it to the insect's head. Attached to the thorax are a butterfly's (1) wings and (2) legs.

Wings. A butterfly has a pair of front wings and a pair of back wings. A network of veins runs through the wings. The veins are mainly filled with air and serve as wing supports. The wings are stiff near the front edges and at the bases. The outer margins of the wings, however, are flexible. They bend when flapped in flight. This bending pushes the air backward and moves the butterfly forward. The front margins of the wings give the insect "lift" as it flies forward.



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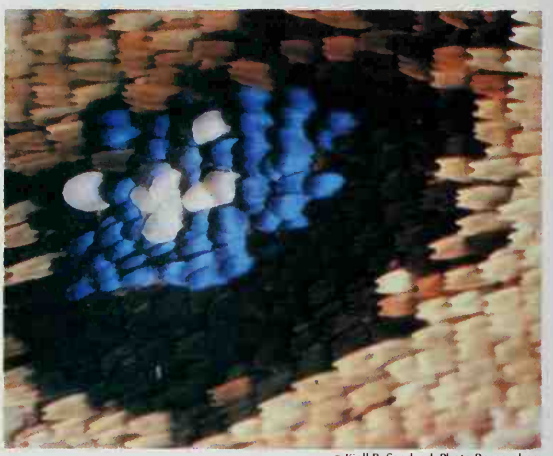

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Overlapping scales cover the wings of butterflies. The scales give the wings their color and pattern. These close-up photographs show how the scales are set in the wings.

Butterflies and moths cannot fly if their body temperature is less than 86° F. (30° C). At air temperatures below this point, they must "warm up" their flight muscles either by sunning their bodies or by shivering their wings. The flight muscles then absorb enough heat to make flight possible.

The size of a butterfly's body and wings determines how the insect flies. For example, milkweed butterflies and swallowtails have small, lightweight bodies and large wings. These butterflies can fly by beating their wings slowly. They are excellent gliders and can fly great distances. On the other hand, skippers have large, heavy bodies and small, pointed wings. They must beat their wings rapidly to stay aloft. Skippers do not soar or glide, but they can fly swiftly for short distances.

A butterfly's wings are covered with tiny, flat scales that overlap. The scales provide color and form beautiful patterns. Some scales contain *pigment* (coloring matter). Colors produced by pigment include black, brown,

red, white, and yellow. Other kinds of scales produce color by reflecting light from their surfaces. Shiny, metallic colors—for example, blue and green—are reflected colors.

Legs. Butterflies have three pairs of legs. Each leg has five main segments. Joints between the segments enable a butterfly to move its legs in various directions. Each leg ends in a pair of claws and hairy pads. The insect uses the claws to grip surfaces. The hairs on the pads are taste organs. Butterflies have weak legs and can walk only short distances.

In some species, the front legs are very short. These "brush feet" are useless for walking, but the taste organs on them are highly developed. By brushing or scraping leaves with these feet, brush-footed butterflies can determine whether particular plants are good sources of food or suitable places on which to lay eggs.

The abdomen chiefly contains a butterfly's reproductive organs. It also has organs for digesting food and for getting rid of waste products.

The internal organs of butterflies are grouped into five main systems: (1) circulatory, (2) nervous, (3) respiratory, (4) digestive, and (5) reproductive.

The circulatory system carries blood throughout the body by means of a long tube that lies just under the exoskeleton of the back. The tube extends from the head to the end of the abdomen. The heart, the pumping part of the tube, lies in the thorax. The blood empties out of the tube into the head. It then floods the entire body. The blood reenters the tube through little openings along the sides. A butterfly's blood is yellowish, greenish, or colorless. It carries food, but not oxygen, to the cells of the body.

The nervous system of butterflies consists of a brain, which is located in the head, and two nerve cords that run through the thorax and abdomen. Small bundles of nerve cells along the cords branch out to all parts of the body.

The respiratory system carries oxygen to the cells of the body and takes away carbon dioxide. Oxygen enters the body through tiny holes, called *spiracles,* located along the sides of the body. Each spiracle connects to a tubelike structure called a *trachea.* The tracheae branch out to all the cells of the butterfly's body. In this way, the body cells obtain oxygen directly from the air rather than from the blood.

The digestive system is basically a long tube that extends from the mouth to the *anus,* an opening at the end of the abdomen. After nectar has been sucked up by the proboscis, it passes to the *gut,* where nourishing substances in the food are absorbed. The remaining waste products pass through the *hindgut* and out of the body through the anus.

The reproductive system. Butterflies reproduce sexually—that is, a new butterfly can be created only after a *sperm* (male sex cell) unites with an *egg* (female sex cell). Female butterflies have a pair of organs, called *ovaries,* in which eggs develop. Male butterflies have a sperm-producing organ, called the *testis.* A tube carries the sperm from the testis to a tube that extends to the outside of the insect's abdomen. The male places the sperm into an organ in the female called the *copulatory sac.* The *sperm duct* transports the sperm to a tube called the *oviduct,* where fertilization takes place.

The life cycle of butterflies

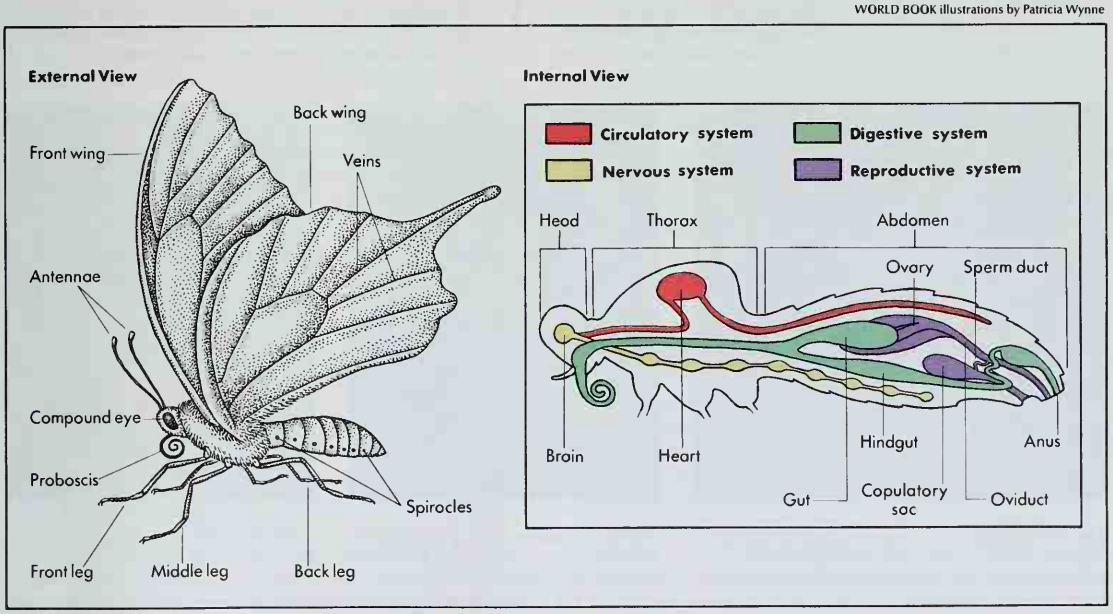
The life of an adult butterfly centers on reproduction. The reproductive cycle begins with courtship, in which the butterfly seeks a mate. If the courtship proves successful, mating occurs.

Butterflies use both sight and smell in seeking mates. Either the male or the female may give signals, called

The anatomy of a butterfly

A butterfly's body has three main parts: (1) the head, (2) the thorax, and (3) the abdomen. The drawings below show the chief external features and internal organs of a typical female butterfly.

WORLD BOOK illustrations by Patricia Wynne



cues, of a certain kind or in a particular order. If a butterfly presents the wrong cue, or a series of cues in the wrong sequence, it will be rejected.

In courtship involving visual cues, a butterfly reveals certain color patterns on its wings in a precise order. Many visual cues involve the reflection of ultraviolet light rays from a butterfly's wing scales. The cues are invisible to the human eye, but butterflies see them clearly. The visual cues help the insects distinguish between males and females and between members of different species.

Usually, a butterfly that presents an appropriate scent will be immediately accepted as a mate. The scent comes from chemicals, called *pheromones,* that are released from special wing scales. A pheromone may attract a butterfly a great distance away.

In most cases, the male butterfly dies soon after mating. The female goes off in search of a place to lay her eggs. She usually begins laying the eggs within a few hours after mating.

Every butterfly goes through four stages of development: (1) egg, (2) larva, (3) pupa, and (4) adult. This process of development through several forms is called *metamorphosis.*

The egg. Butterfly eggs vary greatly in size, shape, and color. Some eggs are almost invisible to the human eye. The largest ones are about $\frac{1}{10}$ inch (2.5 millimeters) in diameter. The eggs may be round, oval, cylindrical, or other shapes. Most are green or yellow. A few species have orange or red eggs. Some eggs are smooth. Others have ridges and grooves.

Most female butterflies lay their eggs on plants that will provide the offspring with food. Before depositing the eggs, the female may "taste" a plant with special organs on the ends of her front legs to make sure the plant is suitable. Some females lay their eggs near a plant or drop them at random while flying. After hatching, the young must find the food themselves.

While laying the eggs, the female fertilizes them with sperm that she had stored in her body after mating. Each egg has a small hole through which sperm can enter. Depending on the species, a female may lay several dozen eggs or clusters of up to hundreds of eggs. A sticky substance deposited with the eggs helps hold them on the plant. The eggs of some butterflies hatch in a few days, but others take months. Eggs laid in fall may not hatch until spring.

The larva, or caterpillar, emerges from the egg and immediately begins its main activity—eating. A caterpillar's first meal is usually its own eggshell. It then begins to eat the nearest food. The majority of caterpillars feed on green plants. In one day, a caterpillar may eat many

The life cycle of a butterfly

A butterfly goes through four stages of development: (1) egg; (2) larva, or caterpillar; (3) pupa; and (4) adult. This process of development is called *metamorphosis.*

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The egg is typically green or yellow. The eggs of some species hatch in a few days, but others take months.

After emerging from the egg, a caterpillar immediately begins to eat. This photograph shows a newly hatched caterpillar eating its own eggshell.

The larval stage lasts two weeks or more. During this period, a caterpillar eats leaves and grows rapidly. After reaching full size, *above,* it is ready to become a pupa.

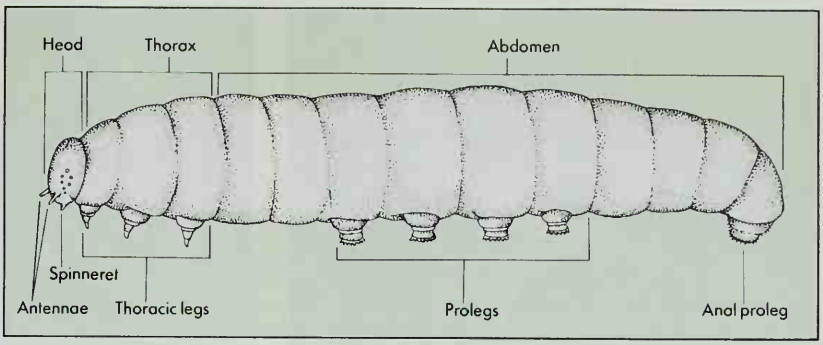
Hanging from a twig, a pupa starts to form a hard shell, *above.* Inside the shell, larval structures will re-form into those of an adult butterfly.

© David Overcash, Bruce Coleman Inc.

A newly formed monarch butterfly pulls free of its pupal shell, *above.* About an hour after leaving its shell, it may be ready to fly.

The anatomy of a caterpillar

The body of a caterpillar is made up of 14 segments. The first segment consists of the head. The next three segments form the thorax. The last 10 make up the abdomen.



WORLD BOOK illustration by Patricia Wynne

times its weight in food. Much of this food is stored in the body and used to provide energy in later stages of development.

Most caterpillars are solid green or brown. Many others have patterns of yellow, red, or other bright colors. Some caterpillars have smooth skin. Many others have bristly hair, bumps, fleshy knobs, or eyespots. All these features help protect caterpillars from enemies by making them hard to see or so frightening in appearance that enemies avoid them.

A caterpillar's body is made up of 14 segments. The first segment consists of the head, which includes chewing mouthparts and two short, thick antennae. The head also has six small eyes on each side. The eyes cannot form images, but they help the caterpillar distinguish between light and dark.

The next three segments of the caterpillar's body make up the thorax. Each of these segments has two short, jointed legs with a sharp claw at each tip. The remaining 10 segments form the abdomen. Most caterpillars have a pair of false legs, known as *prolegs,* on the seventh, eighth, ninth, and tenth body segments. At the end of each proleg are tiny hooks. The last segment has a pair of suckerlike legs called *anal prolegs* or *anal claspers.* This variety of legs enables the caterpillar to cling to plants and to move about.

A short structure called a *spinneret* sticks out below the caterpillar's mouth. It releases a sticky liquid that hardens into a silken thread and gives the caterpillar a foothold wherever it goes. The larva, like the adult, breathes through spiracles on the sides of the body.

The larval stage lasts at least two weeks. During that time, the caterpillar grows rapidly. Its exoskeleton, however, does not grow. When the skin becomes too tight, it splits lengthwise along the back. But before the exoskeleton splits, the larva forms a new skin under the old one. It then crawls out of the old skin. The new exoskeleton is soft, and the larva stretches it to provide growing room. The larva then lies motionless a few hours as the new exoskeleton hardens. Most caterpillars *molt*—that is, shed their exoskeletons—four or five times.

The pupa. After a caterpillar reaches its full size, it is ready to become a pupa. In preparation for this stage, most moth larvae spin silken cocoons around themselves. However, only a few butterfly species spin cocoons. Instead, the typical butterfly caterpillar finds a sheltered spot, usually high on a twig or leaf, and deposits sticky liquid from its spinneret. The liquid quickly hardens into a silklike pad. The exoskeleton then begins to split near the head, and the pupa starts to emerge. As the exoskeleton falls from the tail, the pupa thrusts its *cremaster*—a many-clawed structure at the end of the abdomen—into the pad. This procedure is dangerous. If it does not grasp at the pad fast enough, the pupa may fall to the ground and die.

Many pupae hang head downward, supported only by the cremaster hooked into the silken pad. Other pupae are positioned head upward. Such a pupa has an additional support of silken thread spun around the thorax and the twig or leaf to which it is anchored.

The pupa is soft at first, but a hard shell immediately begins to form over it. Some shells have unusual shapes and colorful patterns. In some cases, the shell has a golden shimmer, and so scientists call the pupa a *chrysalis.* This word comes from the Greek word *chrysos,* which means *gold.*

The pupa is motionless and is often called a "resting stage." However, much activity occurs within the shell. Larval structures are being broken down and re-formed into those of an adult butterfly. Only the internal organs remain basically the same.

The pupal period ranges from a few days to more than a year, according to the species and the time the pupal stage begins. Many species spend the winter as pupae and emerge as adults in the spring.

The adult. After the adult butterfly has formed, its body gives off a fluid that loosens it from the pupal shell. The thorax swells and cracks the shell. The head and thorax then emerge. Next, the butterfly pushes its legs out and pulls the rest of its body free. The entire process may take only a few minutes.

The exoskeleton of the newly emerged butterfly is soft. The wings are damp and crumpled. The proboscis is split in half lengthwise. The butterfly uses its muscles to pump air and blood through its body and wings. The butterfly's exoskeleton hardens, and the legs and other body parts become firm. The wings flatten and expand. Using its front legs, the butterfly joins the halves of its proboscis together. About an hour after leaving the pupal shell, the adult butterfly may be ready to fly.

Most adult butterflies live only a week or two, but some species may live up to 18 months. Most butterflies feed only on nectar, which provides quick energy but does not contain life-prolonging proteins. Certain species of butterflies obtain proteins by feeding on moist, decaying animal matter. Some other species obtain proteins from pollen, which they pick up while feeding on nectar. A number of butterflies do not feed on anything.

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Protective coloration helps many butterflies escape their enemies. The two butterflies above are hard to see because their color blends with their surroundings.

© Edward S. Ross

A swarm of monarch butterflies rests on a branch after migrating south for the winter. Monarchs may migrate from as far north as Canada to California, Florida, or Mexico.

Instead, these butterflies live on food stored during the larval stage.

How butterflies protect themselves

Butterflies have many enemies, including other insects and birds. To escape their enemies, butterflies have developed various means of self-defense.

Many butterflies and caterpillars escape harm because they blend with their surroundings. This form of defense is known as *protective coloration*. Butterflies may look like bark or other vegetation. Most caterpillars are green or brown. Green ones blend with the plants they eat. Brown ones look like dead leaves or twigs.

Many butterflies have chemical defenses. Among certain swallowtails, the caterpillar has an organ just behind the head that gives off an unpleasant odor when the caterpillar is disturbed. Some butterflies are protected as both larvae and adults because they taste bad to enemies. During the larval stage, many of these butterflies eat plants that have bitter or poisonous juices. The juices are stored in the tissues, making the insects distasteful to enemies. Most such butterflies have bright colors and so advertise that they taste unpleasant. This form of protection is called *warning coloration*. An animal that has eaten one of these butterflies will probably avoid eating another butterfly with that coloration.

Some nonprotected butterflies resemble, or *mimic*, distasteful species. Enemies cannot tell them apart and so leave both alone. The most familiar mimic in North America is the viceroy butterfly, which looks like the monarch butterfly. Enemies avoid the viceroy because the monarch tastes unpleasant. Some protected butterflies even resemble other protected ones. By mimicking each other, these insects gain extra protection.

Hibernation and migration

Butterflies cannot live actively in cold weather. They must either hibernate or migrate to warmer areas.

Hibernation. Many species of butterflies survive the winter by hibernating in a sheltered place. Butterflies may hibernate in the egg, larval, pupal, or adult stage. But each species usually hibernates in only one stage, and it is as pupae in most cases.

Just before hibernation, the blood of a larva, pupa, or adult produces substances called *glycols*. These substances are related to the antifreeze used in automobiles. Scientists believe the production of glycols may be triggered by the decreasing daylight that occurs as winter approaches. The presence of glycols enables the insect to survive even the severest cold. After warm weather returns, the glycols are gradually replaced by normal blood substances.

Migration. A few kinds of butterflies escape the winter by migrating to a warmer region. One species, the monarch, is a long-distance champion. Dense clouds of monarchs may travel up to 2,000 miles (3,200 kilometers) from Canada and the Northern United States to California, Florida, and Mexico.

The butterflies spend the winter resting and conserving energy for their return flight in the spring. Few of the adults live long enough to complete the return trip. Female monarchs lay eggs along the way back. The offspring, after maturing, continue the northward journey. Other migrating butterflies include the painted lady, the cabbage butterfly, the red admiral, and the clouded yellow.

How to collect butterflies

Collecting butterflies can be a fascinating hobby. Some large, elaborate collections include rare and valuable specimens and are worth much money. But even a small, inexpensive collection can be interesting and attractive.

The equipment you need to collect butterflies includes a long-handled net, a poisoning jar with an airtight lid, and a poison called *ethyl acetate*. You also need

cotton, a tweezers, mounting pins, mounting boards, and display boxes. All the equipment can be purchased at a hobby or craft store. But many of the items can be made from materials at home.

Capture the butterflies with the net and place them in the poisoning jar, which contains cotton soaked with ethyl acetate. Fumes from the poison will kill the butterflies. Use the tweezers to remove the dead butterflies from the jar. Place the body of each insect in the groove in the mounting board and insert a pin through the thorax. Spread the wings fully and pin threads or thin strips of paper over the wings to hold them in place. After the specimens have dried, remove them from the board and mount them on cardboard or some other material. Label each butterfly specimen with its name and where and when it was captured. Then put the butterflies in a glass-covered box to protect them from moisture and other damage.

To obtain perfect butterfly specimens, some collectors capture caterpillars and raise them to maturity. Such a collector must determine the species so that the caterpillars can be fed the proper food. The collector can watch the larvae become pupae and then adult butterflies.

You can learn more about collecting butterflies by reading books on butterflies available in libraries and by viewing museum collections. Some butterfly collectors join clubs in which the members exchange information and trade specimens. Lee D. Miller

Scientific classification. Butterflies belong to the order Lepidoptera, which also includes moths. Skippers make up the superfamily Hesperioidea, as well as the family Hesperiidae. All other butterflies are *true butterflies* and belong to the superfamily Papilionoidea. True butterflies include the following families: blues, coppers, and hairstreaks (Lycaenidae); brush-footed butterflies (Nymphalidae); sulphurs and whites (Pieridae); metalmarks (Riodinidae); satyrs and wood nymphs (Satyridae); swallowtails (Papilionidae); milkweed butterflies (Danaidae); and snout butterflies (Libytheidae).

Related articles in *World Book* include:

Caterpillar	Insect
Chrysalis	Larva
Compound eye	Metamorphosis
Entomology	Molting
Flower (picture: Pollination by butterflies)	Moth
	Pheromone
Hibernation	Pupa

Outline

I. Kinds of butterflies
- A. Skippers
- B. Blues, coppers, and hairstreaks
- C. Brush-footed butterflies
- D. Sulphurs and whites
- E. Metalmarks
- F. Satyrs and wood nymphs
- G. Swallowtails
- H. Milkweed butterflies
- I. Snout butterflies

II. The bodies of butterflies
- A. The head
- B. The thorax
- C. The abdomen
- D. The internal organs

III. The life cycle of butterflies
- A. The egg
- B. The larva
- C. The pupa
- D. The adult

IV. How butterflies protect themselves

V. Hibernation and migration
- A. Hibernation
- B. Migration

VI. How to collect butterflies

Questions

How do most butterflies that taste bad to their enemies advertise their unpleasant taste?
Why must a caterpillar shed its skin to grow? What is this process called?
How do skippers differ from all other butterflies?
What change occurs in a butterfly's blood that enables the insect to hibernate during the winter?
How do butterflies find mates?
What kinds of equipment does a person need to collect butterflies?
How long do most butterflies live?
What are "brush feet"? How do butterflies use them?
What are the four stages of development in butterflies?
How do butterflies differ from moths?

Additional resources

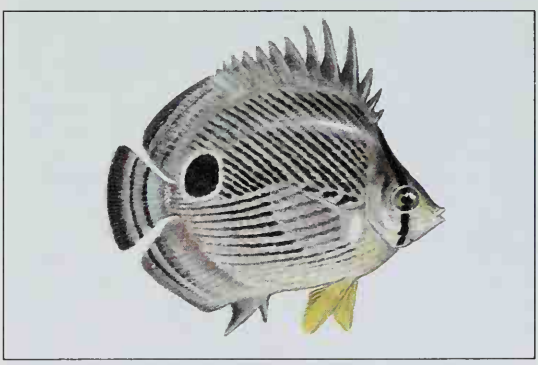
Level I

Feltwell, John. *Butterflies and Moths.* D K Pub., 1993.
Hamilton, Kersten R. *The Butterfly Book: A Kid's Guide to Attracting, Raising, and Keeping Butterflies.* John Muir, 1997.
Pascoe, Elaine. *Butterflies and Moths.* Blackbirch Pr., 1997.
Pringle, Laurence P. *An Extraordinary Life: The Story of a Monarch Butterfly.* Orchard Bks., 1997.

Level II

Douglas, Matthew M. *The Lives of Butterflies.* Univ. of Mich. Pr., 1986.
Mikula, Rick. *Garden Butterflies of North America.* Willow Creek Pr., 1997.
Pyle, Robert M. *Handbook for Butterfly Watchers.* Houghton, 1992.
Sbordoni, Valerio, and Forestiero, Saverio. *Butterflies of the World.* Firefly Bks., 1998.

Butterflyfish is a colorful fish that lives around coral reefs in tropical, subtropical, and temperate seas. There are about 115 species of butterflyfish. Many are popular in home aquariums. Butterflyfish have thin, oval bodies and measure about 4 to 9 inches (10 to 23 centimeters) long. Almost all species of butterflyfish have a dark, vertical bar on the head that passes through the eyes. Most species also have patterns of bars, stripes, lines, spots, or other markings on the body.



WORLD BOOK illustration by John F. Eggert

The foureye butterflyfish has a large, dark eyespot on each side of its body toward the rear. Like most other butterflyfish, the foureye also has many other markings on the body, including a dark, vertical bar that passes through the eyes.

Butterflyfish feed on algae and small animals on or near coral reefs. Some species have long snouts that allow them to reach into narrow cracks in coral for food. A few species of butterflyfish feed on *plankton* (tiny water organisms) in waters above the reefs. Most butterflyfish search for food during the day and rest in the reefs at night.

The *foureye butterflyfish* is common in the Atlantic Ocean from Massachusetts to Brazil. Young foureye butterflyfish have two dark spots called *eyespots,* on each side of the body toward the rear. Adult foureyes have only one eyespot on each side. The eyespots are believed to help protect the fish from its enemies. Predators confuse the rear end of the fish with the front end and do not know which end to attack.

Scientific classification. Butterflyfishes belong to the family Chaetodontidae. The foureye butterflyfish is *Chaetodon capistratus.* Tomio Iwamoto

Buttermilk is the milky liquid remaining after cream has been churned to make butter. *Sweet natural buttermilk* comes from fresh cream that has been chilled and churned. *Sour natural buttermilk* comes from cream *ripened* (soured) by adding lactic-acid-producing bacteria, called a *starter.* Natural buttermilk does not keep well as a fresh beverage. But sweet natural buttermilk is sometimes dried into a powder and used commercially in cooking, baking, and making ice cream.

Cultured buttermilk is made by adding a starter to pasteurized skim milk and allowing it to sour until it curdles. Cultured buttermilk is a popular beverage. It should be kept chilled in a closed container because the beverage absorbs mold, yeast, and bacteria if exposed to air.

Most kinds of buttermilk have about the same food value as milk. However, buttermilk contains less fat and fat-soluble vitamins than milk does. Buttermilk, which is often concentrated, serves as feed for farm animals.

Sidney L. Spahr

See also **Butter; Lactic acid; Milk.**

Butternut, or *white walnut,* is a medium-sized spreading tree that belongs to the walnut family. It grows in the Eastern United States from Maine to Minnesota and south to Arkansas and Georgia.

The tree's light gray bark has broad, flat, diamond-shaped ridges. The leaves have 11 to 17 pointed leaflets, which are hairy and sticky. Butternut fruits are oblong and pointed. They grow in clusters of up to five fruits. Each fruit consists of a nut inside a hard shell that is covered with a greenish-brown husk. The husk is spongy and covered with sticky hair. When the nuts are soft and green, they can be preserved as pickles. When hard and ripe, the nuts taste sweet and are very oily.

Butternut wood is light brown with a satinlike luster. It is soft, light-weight, and coarse-grained. The wood is used for carvings and to make furniture. Sometimes the tree's sap is used to make sugar. The husks have medicinal properties. Pioneers dyed homespun clothing with yellow or orange dye from the husks and bark of butternut trees.

Scientific classification. The butternut tree is in the walnut family, Juglandaceae. Its scientific name is *Juglans cinerea.*

Kenneth R. Robertson

See also **Tree** (Familiar broadleaf and needleleaf trees [picture]); **Walnut.**

Butterwort is one of a group of plants that trap insects. The *common butterwort* is native to North America, Europe, and Asia. It grows in bogs and meadows from Alaska to Oregon and east to New England. Three other species grow in bogs in the Southeastern United States.

A butterwort plant has a cluster of fleshy leaves that lie close to the ground and produce a sticky substance that attracts insects. When an insect settles on a leaf, the edges curve in and trap it. The insect dies and is digested by the plant. The common butterwort has violet-colored flowers on long, slender stems.

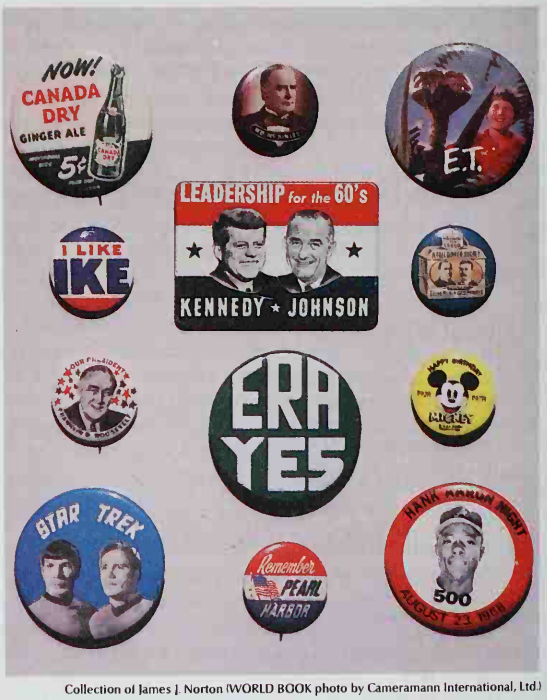
John Markham, Bruce Coleman Ltd.

A butterwort plant traps insects in its leaves for food.

Scientific classification. The butterwort belongs to the bladderwort family, Lentibulariaceae. The common butterwort is *Pinguicula vulgaris.* Norman L. Christensen, Jr.

See also **Carnivorous plant; Leaf** (picture: Insect-capturing leaves).

Button is a disk or other object used to hold a garment closed. The button is attached to one side of the gar-



Collection of James J. Norton (WORLD BOOK photo by Cameramann International, Ltd.)

Pin-back buttons are worn to demonstrate support for a political candidate or a cause, to advertise a product, to commemorate a historical event, or merely to communicate a message.

WORLD BOOK photo by Cameramann International, Ltd.

Antique buttons may have historic or artistic value. People who collect buttons often study the history of buttons, display their collections, and trade buttons with other collectors.

WORLD BOOK photo by Cameramann International, Ltd.

Modern buttons come in many shapes and sizes. They are made of such materials as plastic, wood, and leather.

ment and is passed through a buttonhole or a loop on the other side. Buttons are also used as decoration for clothing. Another type of button—called a *pin-back,* or *lapel, button*—consists of a printed message or a picture on the front and a pin on the back. These buttons are pinned to clothing to show support for a candidate or a cause, advertise a product, commemorate an event, or merely communicate a message or slogan.

The word *button* comes from the French word *bouton,* which means *bud* or *knob.* Clothing buttons are made of such materials as bone, cloth, glass, metal, plastic, shells, and stones. Most pin-back buttons are metal.

History. Nobody knows exactly when people first used clothing buttons, but archaeologists have found bone buttons that date back to prehistoric times. The ancient Greeks and Romans wore buttons both as ornaments for clothing and as fasteners.

Europeans first used buttons only as decoration for clothing. People used strings, pins, or belts rather than buttons to fasten their clothes. Buttons gained use as fasteners during the 1200's, when fitted garments became popular. During this time, the buttonhole was invented. People used dozens of bronze or wooden buttons to fasten the front of their clothes. The rich had costly, beautiful buttons of gold or silver set with gems.

During the late 1700's, portrait and picture buttons became popular in France. Portrait buttons carried the profiles of important men and women. Picture buttons showed trees, flowers, and other scenes. After the French Revolution (1789-1799), buttons with pictures of patriotic subjects, such as war heroes and the French flag, appeared in France. These buttons began the tradition of wearing buttons with a slogan or other message. Pin-back buttons came into widespread use in the United States in 1896, during the presidential race between William McKinley and William Jennings Bryan.

Button legends. In the 1500's, buttons were added to men's coat cuffs. One legend says that these buttons prevented men from wiping their mouths on their sleeves. However, the buttons probably were used originally to close slits at the bottom of the sleeves. Later, coat sleeve buttons became merely decorative.

The custom of placing men's buttons on the right side of a garment and women's buttons on the left may have come about because most people are right-handed. According to one theory, buttons were placed on the right side to make it easy for men to get dressed. The arrangement was reversed on women's clothing to make it easier for maids to dress wealthy women. Another story says that placing buttons on the right enabled men to unbutton their coat with the left hand while drawing a sword or other weapon with the right.

Button collecting is a popular hobby. Some hobbyists collect clothing buttons, and others collect pin-backs. Button collectors study the history of buttons, and many mount their collections for display. Hobbyists buy, sell, and trade buttons with other collectors and with dealers. Many hobbyists also belong to organizations for button collectors. Lois M. Gurel

Buxtehude, *BUKS tuh HOO duh,* **Dietrich,** *DEE trihk* (1637?-1707), was a composer and organist. He composed church music, works for organ, and vocal music. He is perhaps best known as an important influence on the German composer Johann Sebastian Bach.

Buxtehude probably was born in Oldesloe, Germany, near Lübeck. Little is known of his early life, but he probably received his first musical training from his father, a church organist. Buxtehude became organist at St. Mary's Church in Lübeck in 1668, remaining there until his death. His skill as an organist and composer made him a leader of the so-called North German school of organ composition.

Beginning in 1673, Buxtehude produced an annual concert series called *Abendmusiken* (evening performances) at St. Mary's. The concerts included his oratorios, semidramatic works on Biblical and devotional themes, and they attracted music lovers from all over Germany. In 1705, Johann Sebastian Bach walked about 230 miles (370 kilometers) to hear him play. Joscelyn Godwin

Buzzard is a name given to many birds of prey. Scientists consider the word *buzzard* to mean certain types of

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The common buzzard, *above,* lives in the Eastern Hemisphere. Buzzards prey on a great variety of animals, including snakes and rodents.

hawks. These hawks belong to a group called *buteos.* They include the *common buzzard* of the Eastern Hemisphere and the *red-tailed hawk, red-shouldered hawk,* and *broad-winged hawk* of the Western Hemisphere. Buzzards have heavy bodies and broad wings. They feed on a wide variety of animals, such as insects, snakes, and rodents.

Other members of the hawk family have the word *buzzard* in their name. These include *honey-buzzards, buzzard-eagles,* and *eagle-buzzards.*

In the Western Hemisphere, people often apply the term *buzzard* to turkey vultures and black vultures. However, scientists consider this use of the term to be incorrect. Richard D. Brown

Scientific classification. Buzzards belong to the family Accipitridae.

See also **Hawk.**

Byars, Betsy (1928-), is an American author of children's books. Her fiction blends humor, psychological insight, and sensitive explorations of modern social problems. She won the 1971 Newbery Medal for *The Summer of the Swans* (1970), which is a story about a girl who is searching for her younger brother with mental retardation.

Byars's other children's books include *Trouble River* (1969), *The TV Kid* (1976), *The Pinballs* (1977), *The Cartoonist* (1978), and *Cracker Johnson* (1985). Byars was born on Aug. 7, 1928, in Charlotte, North Carolina.

Virginia L. Wolf

Byelorussia. See **Belarus.**

Bylaws are the rules that make up the single governing document adopted by an organization. The bylaws should define the basic characteristics of the organization and describe how the organization will operate. Adoption of the first set of bylaws requires a majority vote by the organization's membership. Amending the bylaws usually requires prior notice to the membership and a larger majority vote (most often two-thirds). See also **Parliamentary procedure** (Bylaws). Ned A. Shearer

Byng, *bihng,* **Julian Hedworth George** (1862-1935), was governor general of Canada from 1921 to 1926. He was involved in a political crisis that led British leaders to redefine the role of Canada's governor general.

Byng was born on Sept. 11, 1862, in Barnet, England. In 1917, during World War I, he led the Canadian Corps in the Battle of Vimy Ridge in France. After the war, he was given the title of baron for his military service.

In 1926, Canadian Prime Minister W. L. Mackenzie King asked Byng to dissolve Parliament and call an election. Byng refused to do so, believing that Parliament must first withdraw its support of King. King protested the decision by resigning. He claimed that Byng represented the British government and that Byng's decision amounted to British interference in Canadian affairs. The crisis ended when King became prime minister again later in 1926. Afterward, British leaders agreed that Canada's governor general would be simply a representative of the British crown and not a British government officer.

In 1928, Byng received the title of viscount. He was appointed a field marshal of the British Army in 1932.

Jacques Monet

Byrd, *burd,* **Richard Evelyn** (1888-1957), an American rear admiral, was an Antarctic and Arctic explorer, aviator, and navigator. Between 1928 and 1957, he did more than any other person to direct the exploration of the bleak, frozen continent of Antarctica.

In 1925, Byrd had his first taste of Arctic flying when he commanded the MacMillan Arctic Expedition's airplane flights over Greenland and Ellesmere Island. Byrd and American pilot Floyd Bennett claimed they flew to the North Pole, on May 9, 1926, but some scholars dispute that claim (see **Bennett, Floyd**).

Byrd's first Antarctic expedition, from 1928 to 1930, was equipped with aircraft to fly to the South Pole. The expedition established its Antarctic base, Little America, on the Ross Ice Shelf at the Bay of Whales. On Nov. 28 and 29, 1929, Byrd and his chief pilot, Bernt Balchen, flew to the South Pole.

The second Byrd expedition to Antarctica, which lasted from 1933 to 1935, undertook many scientific research projects. These projects included studies of meteors, cosmic rays, weather, geography, the earth's magnetism, and seismograph studies of the ice that covers Antarctica. Byrd himself manned an advance base most of one winter. Byrd described this experience in his book *Alone* (1938).

In 1939, Byrd commanded the United States Antarctic Service expedition. The expedition built Little America III and sent out five major exploring parties. World War II (1939-1945) forced the expedition to abandon its bases in 1941.

After his service in World War II, the Department of the Navy appointed Byrd officer in charge of Operation Highjump. The expedition explored an area of Antarctica equal in size to that of Germany and France, and did extensive mapping. Byrd made his second flight over the South Pole on Feb. 16, 1947.

Byrd again took charge of the U.S. Antarctic program for the International Geophysical Year of 1957 and 1958. He visited Antarctica in 1955 and 1956, saw Little America V established, and flew over the South Pole for a

Wide World

Polar explorer Richard E. Byrd, *second from the left,* stands at his camp with members of his 1955 expedition to Antarctica.

third time. He worked on plans for future Antarctic explorations until his death.

Byrd was born in Winchester, Virginia. He was the brother of U.S. Senator Harry F. Byrd. He graduated from the U.S. Naval Academy in 1912. He entered naval aviation during World War I and helped plan the transatlantic flight of naval seaplanes. Marie Byrd Land in Antarctica is named after his wife. William Barr

See also **Antarctica** (Exploration by air).

Additional resources

Burleigh, Robert. *Black Whiteness: Admiral Byrd Alone in the Antarctic.* Atheneum, 1998. Younger readers.

Byrd, Richard E. *To the Pole: The Diary and Notebook of Richard E. Byrd, 1925-1927.* Ed. by Raimund Goerler. Ohio State Univ. Pr., 1998.

Rodgers, Eugene. *Beyond the Barrier: The Story of Byrd's First Expedition to Antarctica.* Naval Inst. Pr., 1990.

Byrd, *burd,* **Robert Carlyle** (1917-), a Democrat from West Virginia, has been a member of the United States Senate since 1959. Byrd became *president pro tempore* (temporary president) of the Senate in 2001. He had held the post from 1989 to 1995. Byrd has served in several other leadership posts in the Senate. He was Senate majority leader from 1977 to 1981 and again from 1987 to 1989. From 1981 to 1987, Byrd served as minority leader of the Senate. Byrd was the Democratic *whip* (assistant leader) from 1971 to 1977.

As majority leader, Byrd helped win Senate approval of two Panama Canal treaties in 1978. One treaty provided for Panama to take control of the canal on Dec. 31, 1999. The other gave the United States the right to defend the canal's neutrality.

Byrd was born Cornelius C. Sale, Jr., in Wilkesboro, North Carolina. His mother died when he was 10 months old. Byrd's father sent the boy to live with the family of an uncle, Titus D. Byrd of Stotesbury, West Virginia. The youth, who changed his name to Robert Byrd, became a butcher because he did not have enough money to get a college education.

During the 1940's, Byrd belonged to the Ku Klux Klan for about 18 months (see **Ku Klux Klan**). In 1946, he won election to the West Virginia House of Delegates. He ran for the state Senate in 1950. Byrd won that election even though Democratic Party leaders had withdrawn their support because of his membership in the Klan. Byrd was a member of the U.S. House of Representatives from 1953 to 1959. Charles Bartlett

Byrd, *burd,* **William** (1543-1623), was an English composer known for his religious music. Byrd wrote three masses and many choral works called *motets* for the Roman Catholic Church. He also wrote anthems and psalms for the Church of England. In addition, Byrd composed nonreligious works for chorus and solo voice and chamber music for *viol,* a stringed instrument that was popular during the 1500's. Seventy of Byrd's compositions for the *virginal,* an early small harpsichord, are included in a famous collection called the *Fitzwilliam Virginal Book* (about 1625).

Byrd was probably born in Lincoln and became cathedral organist there in 1563. He moved to London in 1572, where he shared the post of organist at the Chapel Royal with his former teacher, composer Thomas Tallis. In 1575, Queen Elizabeth I granted Byrd and Tallis an exclusive license to issue printed music. They first published a collection of their own motets called *Cantiones Sacrae* (1575). In his later years, Byrd provided music for the Roman Catholic Church. In addition, Byrd taught a number of younger composers. Joscelyn Godwin

Byrd, *burd,* **William, II** (1674-1744), was a wealthy plantation owner and one of colonial Virginia's most prominent government officials. He was elected to the Virginia House of Burgesses in the 1690's and was appointed to Virginia's Royal Council in 1709. He served as Virginia's colonial agent in England for a number of years during the late 1600's and early 1700's.

Byrd was also one of the most significant colonial authors, though none of his writings was published during his lifetime. Byrd's work *History of the Dividing Line* (1841) told of his experience as a commissioner surveying the border between Virginia and North Carolina in 1728. His revealing *Secret Diary,* which was not published until 1941, contains fascinating details of the everyday lives of Virginia's aristocratic planters.

Byrd was born in Westover, Virginia. His father, William Byrd, was also a wealthy planter and public official in colonial Virginia. Robert A. Becker

Byrne, *burn,* **Jane Margaret** (1933-), was the first woman mayor of Chicago. Byrne, a Democrat, served as mayor of the city from 1979 to 1983. She had attracted nationwide attention in the primary election by winning an upset victory over the city's Democratic political organization. In the mayoral election, Byrne received 82 percent of the votes, the highest percentage in Chicago's history.

Byrne was born in Chicago and graduated from Barat College. In 1963, Mayor Richard J. Daley appointed her to work in Chicago's antipoverty program. In 1968, he named Byrne commissioner of consumer sales. She continued in that position in the administration of Michael A. Bilandic, who became mayor after Daley died in 1976.

Jane M. Byrne

Bilandic fired Byrne in 1977 after she criticized him in a dispute over a fare increase for Chicago's taxicabs. Several months later, Byrne announced her candidacy for mayor. Byrne won support from Chicago voters when she attacked the city government for its handling of snow removal following a record snowfall before the 1979 primary.

Byrne again sought the Democratic mayoral nomination in 1983. But Harold Washington, an African American member of Congress, defeated her in the primary. Washington, who won the mayoral election, defeated Byrne again in the 1987 Democratic primary for mayor. Byrne was defeated in the 1991 Democratic primary for mayor by Richard M. Daley. Charles E. Nicodemus, Jr.

Byrnes, *burnz,* **James Francis** (1879-1972), is best remembered as secretary of state under President Harry S. Truman from 1945 to 1947. With the creation of the United Nations in 1945, Byrnes hoped for international cooperation. By 1946, however, conflicts had arisen be-

tween the United States and the Soviet Union over the future of Eastern Europe, Iran, and Germany. Truman became convinced that Byrnes had been too "soft" on the Soviets. In January 1947, General George C. Marshall replaced Byrnes as secretary of state.

Byrnes was born in Charleston, South Carolina. He had little formal education, but read law to prepare himself for that profession. He served as a Democratic representative from South Carolina in Congress from 1911 to 1925 and as a U.S. senator from 1931 to 1941. He became an associate justice of the U.S. Supreme Court in 1941 and served until 1942. As governor of South Carolina from 1951 to 1955, Byrnes attacked racial integration.

Kendrick A. Clements

Byron, Lord (1788-1824), was the most colorful of the English romantic poets. Many people find his adventurous life as interesting as his poetry. Byron often set his poems in Europe and the Near East, and they reflect his own experiences and beliefs. Byron's poetry is sometimes violent, sometimes tender, and frequently exotic. However, the underlying theme is always Byron's insistence that people be free to choose their own course in life.

Byron's life. George Gordon Byron was born in London, but he lived most of his first 10 years in Scotland with his mother. His father, who had abandoned Byron's mother, died when the boy was 3. Byron inherited the title Lord Byron at the age of 10, upon the death of his great-uncle. He then returned to England, where he attended Harrow School and Cambridge University. Byron's first book of poems, *Hours of Idleness* (1807), was severely criticized by the *Edinburgh Review,* a Scottish literary magazine. Byron replied with *English Bards and Scotch Reviewers* (1809), a verse satire in which he attacked almost every notable literary figure of the day.

From 1809 to 1811, Byron traveled through southern Europe and parts of the Near East. In 1812, he published the first two *cantos* (sections) of *Childe Harold's Pilgrimage.* These cantos, set in the countries he had recently visited, chiefly Portugal, Spain, Albania, and Greece, immediately established his fame. Eastern verse tales, such as *The Bride of Abydos* (1813) and *The Corsair* (1814), kept him in the public eye. In 1815, Byron married Anne Isabella Milbanke. They had a brief, unhappy marriage, during which a daughter, Ada, was born. The marriage ended partly because of rumors that Byron had committed incest with his half-sister, Augusta Leigh. Byron left England forever in 1816.

Byron spent several months in Switzerland, where he met fellow poet Percy Bysshe Shelley. Byron then settled in Italy, where he carried on a long romance with the Countess Teresa Guiccioli and became involved in Italian revolutionary politics. Byron also wrote such works as the verse dramas *Manfred* (1817) and *Cain* (1821). His last and greatest work was the long, unfinished epic *Don Juan.* In 1823, while writing this poem, Byron decided to join the Greeks in their war for independence from the Turks. After a brief illness, he died in Missolonghi, Greece.

Byron's poetry. *Hours of Idleness* is mainly a collection of the learned and romantic poses expected of young poets at that time. In *English Bards and Scotch Reviewers,* however, Byron adopted the biting, satiric style used by the poet Alexander Pope in his *Dunciad.*

Oil painting on canvas; National Portrait Gallery, London

Lord Byron was a colorful English romantic poet. Thomas Phillips painted Byron wearing an Albanian costume in 1814.

Byron wrote the first two cantos of *Childe Harold's Pilgrimage* as a fictional allegory using the stanza form and many features of the literary style of the Elizabethan poet Edmund Spenser. This work and the sequence of "Turkish Tales" (1813-1816) that followed defined the character type known as "the Byronic hero." This character is the melancholy, defiant, proudly self-assured man associated with Byron and widely imitated in later literature. In canto III (1816) and canto IV (1818), Byron identifies himself with Harold and through him expresses the loss and defiance the poet felt while living abroad.

During Byron's last years, he wrote several types of works, notably such historical and Biblical tragedies as *Sardanapalus* (1821) and *Cain.* But the masterpiece of his Italian period is *Don Juan.* Byron wrote the poem in the loose, flexible Italian verse form called *ottava rima.* The poem deflates the legendary lover Don Juan to the level of a comic epic hero. The most important element in *Don Juan,* however, is the narrator, a free and self-contradictory spirit whose tone changes continually, ranging through the forceful, biting, sentimental, cynical, self-mocking, and self-assured. The narrator's voice maintains Byron's scorn for what he called *cant,* the deceptions played by individuals and societies upon one another. Despite the range of Byron's poetry, that scorn is the main force running from the beginning to the end of his career.

Frederick W. Shilstone

Additional resources

Garrett, Martin. *George Gordon, Lord Byron.* Oxford, 2000.
Gleckner, Robert F., ed. *Critical Essays on Lord Byron.* G. K. Hall, 1991.
Graham, Peter W. *Lord Byron.* Twayne, 1998.
Peters, Catherine. *Byron.* Sutton, 2000.

Byssinosis. See **Brown lung.**

Detail of a mosaic (early 500's) in the apse of the Church of San Vitale; SCALA/Art Resource

Byzantine art is dominated by Christian themes. In this mosaic from a church in Ravenna, Italy, Jesus Christ sits on a globe symbolizing the universe. He hands a crown to Saint Vitalis, patron of the church. Ecclesius, the archbishop of Ravenna, presents a model of the building, *right.*

Byzantine art, *BIHZ uhn teen* or *bih ZAN tihn,* is the Eastern Christian art that flourished during the time of the Byzantine Empire, from the 300's to the 1400's. In the West, Byzantine art is known chiefly for domed churches with magnificent interiors that feature a variety of highly crafted religious images. Byzantine artists used many costly materials, including gold, silver, and lapis lazuli, to create colorful murals. Religious artworks of a smaller scale, such as books and panel pictures, show a similar interest in elaborate workmanship and luxury materials.

Many Byzantine works of art were produced to serve the imperial court or the imperial religion, which was Eastern Orthodox Christianity. Most Byzantine artists worked as servants of the court or belonged to religious orders, and they often remained anonymous. These artists followed strong conventions that restricted both the content and the form of their work. For example, in Byzantine paintings, tradition often determined the choice of the subject and the arrangement of the figures within the picture. In general, the figures in Byzantine painting appear flat and somewhat abstract to modern viewers.

The development of Byzantine art

In A.D. 330, Byzantium became the capital of the Roman Empire and was renamed Constantinople. In 395, the Roman Empire permanently split into the West Roman Empire and the East Roman, or Byzantine, Empire. The Byzantine Empire included lands along the Mediterranean and Black seas and lasted until 1453. In that year, the Ottomans captured Constantinople. The Ottomans later gave the city its present name, Istanbul. See **Byzantine Empire.**

During the early period of Byzantine art, which began in the 300's and ended in the 600's, architects began to build impressive domed churches. The middle period of Byzantine art started in the 800's and featured smaller churches. During the late period of Byzantine art, which began in the 1200's, artists experimented with more expressive painting styles.

Byzantine art varied over the centuries and also from region to region. The art that developed in Constantinople was imitated in many areas, including Bulgaria, Germany, Italy, Russia, Serbia, and Spain. These areas created their own styles of Byzantine art to suit their particular political, religious, and social needs.

Western artists and audiences tend to value individualism and novelty in art. As a result, they may perceive Byzantine art as impersonal or unchanging. By imposing these Western standards, viewers underrate the richness of Byzantine art.

Architecture

Churches are almost all that survive of Byzantine architecture. Byzantine churches were built mainly of stone, brick, and mortar. They featured plain exteriors and elaborately decorated interiors. This contrast suggested the differences between the daily world outside and the ideal or spiritual universe of the church.

Early Byzantine churches. Four large arches springing from columns or piers defined the *nave* (the central part of the church) and supported a great central dome.

East of the nave lay a sanctuary made up of one large *apse* (semicircular recess) flanked by two smaller ones. A high screen called an *iconostasis* separated the sanctuary from the rest of the church. The clergy performed the elaborate rituals of the service in both the sanctuary and the nave.

The grandest example of early Byzantine churches is the famous Hagia Sophia in Istanbul. Hagia Sophia was built during the 530's and ranks as one of the most remarkable buildings in the history of architecture. The church's great central dome is supported by smaller semidomes that cover the sanctuary to the east and the entrance to the west. See **Hagia Sophia.**

Later Byzantine churches were smaller and more modest than the churches of the early period. In the 800's, Byzantine architects began to build complex domed churches. One example of a later Byzantine church is the Church of the Holy Apostles in Thessaloniki, Greece.

Through the centuries, the architectural plans used in Byzantine churches were modified in Armenia, southern Italy, Russia, Serbia, and Sicily. Architects in each region changed the scheme to fit their own technology, building materials, and cultural or national style.

Frescoes and mosaics

Magnificent *frescoes* and *mosaics* decorate the interiors of Byzantine churches. Frescoes are wall paintings created on damp plaster. Mosaics consist of small pieces of stone or glass fitted together to form a design or picture.

Only a few Byzantine frescoes and mosaics produced before the 800's still exist. Most were destroyed during the 700's and early 800's as a result of a bitter dispute called the *iconoclastic controversy*. This disagreement among Christians concerned the use in churches of images of God and the saints. A group known as iconoclasts opposed the worship of such images and removed or destroyed religious pictures in churches. Many people, particularly monks and women, opposed the iconoclasts. In 843, the Eastern Christian church again permitted the display of religious pictures.

The Eastern Christian church also developed a strict code governing the use of religious images in churches. The church standardized the way holy persons could be

Detail of the *Anastasis* from the Kariye Camii, Istanbul, Turkey; Raymond V. Schoder

A Byzantine fresco from the 1300's shows Jesus Christ dramatically pulling Adam and Eve from their tombs. The wreckage of the gate of hell and its many locks lies beneath Jesus' feet.

SEF/Art Resource

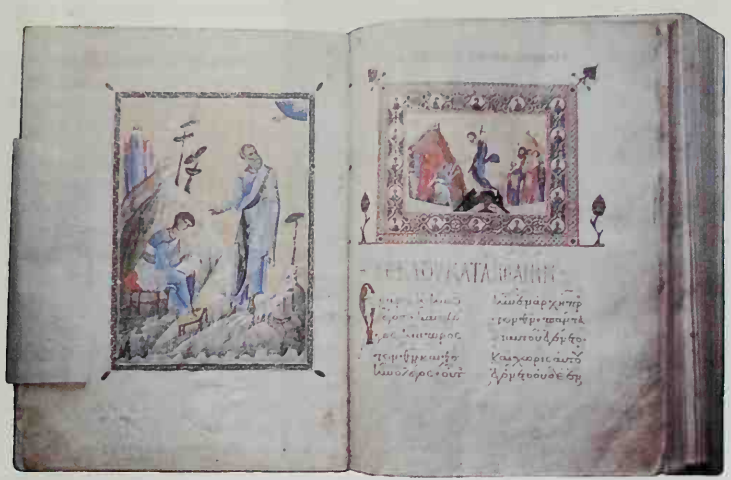
A Byzantine church in Greece called the Church of the Dormition of the Virgin was built in 874. Small towers called *cupolas* rest on the roof of the well-proportioned structure.

Tempera painting on wood (about the 1200's); The Monastery of Saint Catherine, Mount Sinai (Alexandria-Princeton-Michigan Expedition to Mount Sinai)

An icon is a sacred religious painting displayed in homes or in churches. The icon shown above is a portrait of Jesus Christ, a common subject. Icons may also portray God or Christian saints.

Byzantine decorative arts

The Byzantine Empire was famous for its luxury art objects. Artists decorated many books, crosses, and other items with religious images. Examples of Byzantine artistry are shown here.



Illuminated Gospel lectionary (1059) from the Dionysiou Monastery, Mount Athos, Greece; Raymond V. Schoder

Illuminations were paintings that decorated manuscripts. This book is a *lectionary,* in which the Gospels were arranged according to the liturgical year. On the left, Saint John dictates to a disciple. The scene on the right shows Jesus's descent into hell.

Cloisonné enamel cross; © Dumbarton Oaks, Trustees of Harvard University, Washington, D.C.

A reliquary cross from about 1200 represents the Crucifixion. Such crosses served as containers for holy relics.

portrayed, and it formulated an order of rank for images placed on church walls. The code required that a portrait of Jesus Christ occupy the central dome. A portrait of Mary, the mother of Jesus, had to be at the top of the main apse. The middle surfaces of the church walls and columns displayed episodes in the life of Christ. Artists concentrated on a chosen number of scenes, most often from the New Testament, rather than illustrating Biblical stories in chronological sequence. Portraits of the saints and church leaders occupied the lowest wall surfaces.

Most of the portraits in Byzantine churches were frontal views. They were rendered on a solid background created from gold mosaic or from one color of paint. Artists did not try to portray realistic figures and scenes with a sense of spatial depth. Instead, they focused on creating works that evoked spiritual feelings. As a result, the portraits appear flat and somewhat abstract, rather than lifelike.

Following the iconoclastic controversy, Byzantine frescoes and mosaics developed subtle changes in style. The mosaics in the church of Daphni, near Athens, Greece, which date from about 1100, feature an elegant, restrained style. A more dramatic style is represented by the mosaics of the 1100's in the Norman churches in Sicily. Later artists depicted narrative sequences and portrayed more emotional expression. The works feature elongated figures and elaborate detail. The principal masterpieces of the last phase of Byzantine art are the frescoes and mosaics of the 1300's in the church of Kariye Camii in Istanbul.

Other art forms

The Byzantines excelled in many art forms other than frescoes and mosaics. They produced beautiful panel pictures called *icons* and book decorations called *illuminations.* They also worked in various crafts.

Icons are religious images that the Eastern Orthodox Churches consider to be sacred. Many icons are painted on wood and are small enough to be carried in processions. Most Byzantine icons followed the themes and styles of the frescoes and mosaics. They greatly influenced Western artists of the 1200's, including the Italian painters Duccio di Buoninsegna and Giovanni Cimabue.

Byzantine artists illuminated many kinds of manuscripts. They illustrated the margins and pages of Psalm and Gospel books with *miniatures* (small paintings) of Biblical stories. They also decorated *lectionaries* with miniatures of themes for the feast days of the church. Lectionaries were books in which the New Testament was rearranged into readings for feast days.

In the palace workshops, Byzantine craftworkers produced many luxury art objects decorated with religious and imperial images. These included ivory carvings on caskets and plaques, enamel crosses and crowns, gem-studded *reliquaries* (containers for holy relics), silver and gold book covers, and embroidered garments.

The Byzantines did not create much large sculpture. They disapproved of sculpture as an art form, partly because they associated it with what they regarded as pagan statues.

Annabel Jane Wharton

Related articles in *World Book* include:
Architecture (Byzantine architecture)
Byzantine Empire
Clothing (picture: Clothing of early Byzantine times)
Hagia Sophia
Iconoclast
Illuminated manuscript
Mosaic
Painting (Medieval painting)
Russia (The arts)
World, History of the (picture: The Basilica of Saint Mark)

Additional resources

Evans, Helen C., and Wixom, W. D., eds. *The Glory of Byzantium.* Metropolitan Museum, 1997.
Lowden, John. *Early Christian & Byzantine Art.* Phaidon, 1997.

Detail of a mosaic (probably late 900's) by an unknown artist in Hagia Sophia, Istanbul, Turkey; Ara Güler

Two Byzantine emperors, presenting gifts to the Virgin Mary and the Infant Jesus, are shown in this mosaic. Emperor Justinian, *left,* gives her the cathedral Hagia Sophia, and Emperor Constantine, *right,* offers the city of Constantinople.

Byzantine Empire was a continuation of the Roman Empire. It is also known as the *East Roman Empire* because it ruled what had been the eastern part of the Roman Empire. During the A.D. 500's, the period of its greatest size, the Byzantine Empire included parts of southern and eastern Europe, of northern Africa, and of the Middle East.

The Byzantine Empire played several important roles in history. It protected much of Europe from the attacks of barbarians and such eastern invaders as the Arabs and Turks. The Byzantines preserved ancient Greek literature and philosophy, as well as Roman governmental and legal traditions. Christianity, Greek culture, and Roman customs flourished in the empire, which thus served as a link between ancient and modern European civilization.

The people of the Byzantine Empire called themselves *Romans.* The word *Byzantine* comes from *Byzantium,* the Greek name for a city on the Bosporus. The Bosporus, a strait, forms part of a waterway that connects the Black Sea and the Mediterranean Sea. In A.D. 330, the Roman emperor Constantine the Great moved the capital of the Roman Empire from Rome to Byzantium (now Istanbul, Turkey). The city was renamed Constantinople after him. Some historians believe the Byzantine Empire began that year. Others think it began in 395, when the Roman Empire split into the West Roman Empire and the East Roman Empire. The Byzantine Empire ended after the Turks conquered Constantinople in 1453.

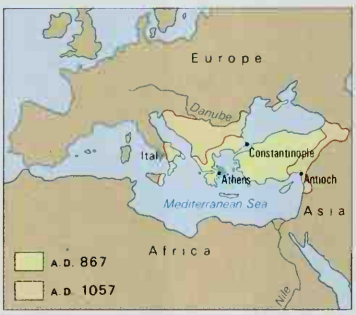
Way of life

The people of the Byzantine Empire were descendants of various ancient peoples. Many Armenians and Slavs lived in the remote areas of the empire. In Constantinople, the upper class included Armenians, Bulgarians, Greeks, Normans, and Turks. The Byzantines spoke Greek.

The majority of Byzantines were poor farmers who lived in one-room huts built of wood or of bricks made of mud. Most houses in Constantinople were made of wood. However, the rich lived in stone mansions, many of which had an enclosed courtyard. Working people of the empire wore short *tunics* (coatlike garments) of wool or linen. The upper classes dressed in long robes of heavy silk decorated with raised designs.

Most of the people ate chiefly bread and cheese, together with vegetables cooked in olive oil. The wealthy enjoyed banquets of meat prepared in strong, gar-

During the A.D. 500's, the Byzantine Empire grew in size. Armies of Emperor Justinian I brought Italy and areas in North Africa and Spain into the empire.



A new period of growth took place from A.D. 867 to 1057, under Emperor Basil I and his descendants. This growth ended about 300 years of decline.

WORLD BOOK maps

The last Byzantine rulers faced advancing Serbs in the Balkans and the Ottoman Turks in Asia Minor. By 1350, the empire covered only a few small areas.

lic-flavored sauces and served with plenty of wine. The Byzantines went to public baths that included hot rooms, steam rooms, and swimming pools. Chariot races were a favorite form of entertainment.

Byzantine culture required women to live partly in seclusion, and large houses had separate sections for them. Most women spent their lives doing household tasks. However, some received an education, and women ruled the empire several times. Empress Theodora, the wife of Justinian I, was one of the most powerful women of the Byzantine Empire. She influenced her husband's policies and used her power to advance her friends and to ruin her enemies. See **Theodora.**

Religion played an important part in the lives of the Byzantines. Constantine the Great converted to Christianity and encouraged his subjects to become Christians. Under Theodosius I, who came to power in 379, Christianity became the official state religion. Byzantine missionaries spread Christianity throughout the empire and converted the Russians and other Slavic peoples. Today, the Eastern Orthodox Churches carry on the Byzantine religious tradition.

Cultural life. Christianity had a strong influence on Byzantine art, music, and architecture. Byzantine art featured pictures of holy people that stressed the sacred quality of the subject, rather than the human quality. These works greatly influenced medieval European artists, especially the Russians. The Byzantines also wrote beautiful hymns and designed elaborately decorated domed churches. See **Byzantine art.**

Constantinople was the educational center of the Byzantine Empire. There, future government officials learned to read and write the language of ancient Greece. This language, which was used for official purposes, differed from a simpler form of Greek spoken by most Byzantines. The Byzantines produced noted works in history and wrote fine poetry, including religious poems. They also created much religious prose.

Economy. Most of the people of the Byzantine Empire lived in villages. They raised grapes, olives, and wheat or herded sheep. Merchants and craftworkers practiced their trades in the towns and large cities. The Byzantines imported silks, spices, and luxury goods from China, and furs, slaves, and timber from Western Europe. Constantinople was an ideal trading center because of its location on the Bosporus and its fine port.

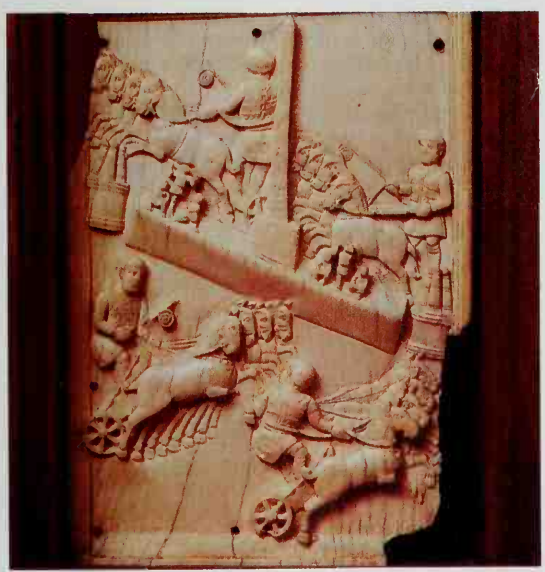
The manufacture of silk textiles became an important Byzantine industry during the A.D. 500's, when silkworms were introduced into the empire. These textiles were exported from Constantinople, along with carved ivory, enamel, glassware, and bronze church doors.

Government. The emperor was the absolute ruler and sole lawmaker of the Byzantine Empire. Under the emperor, the government consisted of an elaborate system of specialized departments with many civilian and military officials. The government controlled almost every aspect of life. For example, manufacturing and selling were strictly regulated. The government also had much influence over church officials. The people paid heavy taxes to support the government.

History

Beginnings. Byzantium was founded by Greeks in the mid-600's B.C. It became part of the Roman Empire in the 100's B.C. In A.D. 306, Constantine the Great became emperor of the western half of the Roman Empire. He became emperor of the entire Roman Empire in 324. In 330, Constantine made Byzantium the capital of the empire because the eastern section had become more important than the western area. The capital was renamed *Constantinople.*

In 395, after the death of Emperor Theodosius, the



Detail of an ivory carving (about A.D. 355) by an unknown artist; Christian Museum, Brescia, Italy (SCALA/Art Resource)

Ara Güler

Byzantine chariot races were held in the Hippodrome in Constantinople (now Istanbul, Turkey). The carving at the left shows chariots racing around a column of the Hippodrome. The photograph at the right shows the Hippodrome today, with Hagia Sophia in the background.

empire was permanently divided into two parts. Germanic invaders gradually took over the western section during the 400's. This area, called the West Roman Empire, collapsed in 476.

The empire under Justinian I. The Byzantine Empire reached its greatest size under Emperor Justinian I, who ruled from 527 to 565. Justinian was determined to bring back the grandeur of the Roman Empire by regaining territory in the west. Under his leadership, Italy, the southeastern coast of Spain, and much of northern Africa were reconquered. The empire had already included Asia Minor (now Turkey), the Balkan Peninsula, Egypt, Palestine, and Syria.

The Byzantines organized many laws of the ancient Romans. This collection of laws became known as the *Justinian Code* and ever since has been the basis of the legal systems of many countries (see **Justinian Code**). Justinian also built Hagia Sophia, the empire's largest and most splendid Christian church. Today, this famous cathedral attracts large numbers of visitors to Istanbul.

Trade thrived during Justinian's reign, and Byzantine art and architecture flourished. But the empire's funds were used up by the high cost of the wars and improvements that took place under Justinian. As a result, the empire was bankrupt when he died in 565.

Invasion and conquest. After Justinian's death, barbarians attacked the empire on all fronts. Lombards from Germany seized parts of Italy, and Slavs and Avars invaded the Balkan Peninsula. Persian invasions weakened the empire during the late 500's and early 600's. Heraclius, who became ruler in 610, temporarily stopped the collapse by defeating the Persians.

A new enemy attacked the weakened empire in 634, when Muslim Arabs invaded its Middle Eastern territory. By 642, the Arabs had conquered Syria, Palestine, and Egypt. By the early 700's, the empire consisted only of Asia Minor, the Balkan coast, Crete and other Greek islands, southern Italy, and Sicily. In the 700's and early 800's, Byzantine emperors tried to end the worship of images of Jesus Christ and the saints. Churches in the western part of the empire opposed this action. The dispute nearly split the empire. See **Iconoclast**.

Detail of a mosaic (early 500's) in the church of San Vitale, Ravenna, Italy; SCALA/EPA, Inc.

Empress Theodora, shown here with members of her court, was one of the most powerful women of the Byzantine Empire.

During the 800's, the empire began to expand again. Byzantine armies drove the Arabs back on several fronts. From 867 to 1025, under Emperor Basil I and his descendants, the empire achieved another major period of success. Basil began work on a new code of laws. Leo VI, who came to power in 886, completed the code and encouraged artists and scholars. Constantine VII, the ruler from 913 to 959, continued to encourage the arts. He also wrote handbooks on government. Basil II, who became emperor in 976, regained territory in eastern Asia Minor and reconquered Bulgaria. Trade grew in addition to this expansion, and the empire prospered.

A quarrel with the West began in 1054. That year, a dispute over the pope's authority in the empire led to a break between the churches in the western and eastern sections (see **Eastern Orthodox Churches**).

The decline and end of the empire. The Byzantine Empire began to collapse again during the 1000's. By 1071, the Normans had taken southern Italy. That same year, in Asia Minor, the Seljuk Turks defeated a Byzantine army in the Battle of Manzikert. This defeat began the decline of Byzantine control of Asia Minor. Emperor Alexius Comnenus, who came to power in 1081, asked the Christians of Western Europe to help defend the empire against the Turks. The Turks had invaded the Holy Land in addition to the Byzantine Empire. The military expeditions of the Christians against the invaders of the Holy Land became known as the Crusades. During the First Crusade, from 1096 to 1099, crusaders regained the coastal regions of the Holy Land.

Later crusades resulted in increased tension between the Byzantines and the West European Christians. In 1204, during the Fourth Crusade, religious hatred played a key role in the capture of Constantinople by Western forces. This conquest occurred partly because merchants from the Italian city of Venice wanted to gain control over trade in the Middle East. The Venetians and the crusaders established a new empire and kept the government in Constantinople.

Members of the court of the defeated Byzantines established bases in Asia Minor. The Byzantines recaptured Constantinople in 1261. But Ottoman Turks soon invaded Asia Minor, and the Serbs advanced in the Balkans. Civil wars also weakened the empire.

By the late 1300's, Constantinople and part of Greece were all that remained of the empire. The empire ended in 1453, when Ottoman Turks captured Constantinople. The last Byzantine emperor, Constantine XI, died while defending the city.

Charles M. Brand

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Additional resources

Browning, Robert. *The Byzantine Empire.* Rev. ed. Catholic Univ. of Am. Pr., 1992.

Norwich, John J. *Byzantium.* 3 vols. Knopf, 1989-1995. *A Short History of Byzantium.* 1997.

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